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Water Resource Report 66

1996

GROUNDWATER RESOURCES OF DELAWARE COUNTY, PENNSYLVANIA

Wayne T. Balmer
Drew K. Davis
U.S. Geological Survey

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by Wayne T. Balmer and Drew K. Davis
U.S. Geological Survey

Prepared by the United States Geological Survey, Water Resources Division, in cooperation with the Pennsylvania Geological Survey

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ABSTRACT

Delaware County, Pa., is a densely populated area that has limited water resources. The county lies mostly in the Piedmont physiographic province, which is characterized by gently rolling hills, and partly in the Atlantic Coastal Plain physiographic province, which is characterized by a relatively flat landscape. The bedrock consists of metamorphic and igneous rocks. Thin terrace and unconsolidated deposits, characteristic of the coastal plain, cover approximately 28 percent of the county.

Groundwater occurs mostly in the weathered zone above bedrock and in fractures to depths of about 300 feet below land surface. The amount of groundwater that goes into storage annually equals approximately half of the amount of annual precipitation. About 62 percent of the water distributed by public water suppliers is imported from sources outside the county.

The Wissahickon is the most productive water-bearing formation, although the median yield is only 20 gallons per minute. The ultramafite has a median yield of 18 gallons per minute, and the other crystalline units have median yields of 10 gallons per minute or less. The unconsolidated deposits are too thin to support major water withdrawals. None of the geologic formations in Delaware County yield enough water consistently for large public or industrial supplies; however, most wells should produce sufficient quantities for domestic purposes. Water quality is generally suitable for most uses except where manganese and iron are present in water from wells in the Wissahickon Formation, and where groundwater has been locally contaminated.

INTRODUCTION

PURPOSE AND SCOPE

This report is part of a continuing program conducted by the U.S. Geological Survey, Water Resources Division, in cooperation with the Pennsylvania Department of Conservation and Natural Resources, Bureau of Topographic and Geologic Survey, to investigate the water resources of Pennsylvania. Its purpose is to summarize the geohydrology and groundwater resources of Delaware County, Pa. The scope of this report includes descriptions of the geology; hydrology; the occurrence, movement, availability, and chemical quality of the groundwater in the geologic units of Delaware County; and the potential of those units as groundwater sources.

DESCRIPTION OF STUDY AREA

Delaware County encompasses an area of 185 square miles in the southeastern corner of Pennsylvania (Figure 1). Most of the county lies within the Piedmont physiographic province except for a narrow belt along the Delaware River that lies within the Atlantic Coastal Plain physiographic province (Figure 2). The Piedmont province is characterized by a gently rolling landscape having a few low hills and ridges. The predominant bedrock units are metamorphic rocks. The Atlantic Coastal Plain province is differentiated physiographically from the Piedmont province by its flatter topography. It is separated from the Piedmont province by the Fall Line, which is marked by a sharp change in elevation, the Piedmont being higher. The majority of Atlantic Coastal Plain deposits have been eroded, leaving metamorphic bedrock partially overlain by the discontinuous Cenozoic deposits (Owens and Minard, 1979) and unconsolidated terrace deposits.

All of Delaware County lies in the Delaware River drainage basin. The major streams flow from the northwest to the southeast across the county and discharge into the Delaware River estuary. Cobbs Creek is part of the northeastern boundary of the county. Brandywine Creek forms the boundary to the southwest and drains into the Christina River at Wilmington, Del., and then into the Delaware River. Only the extreme southwestern corner of the county is drained by Brandywine Creek.

Public water companies supply water to most urbanized communities and draw primarily from surface-water sources. Groundwater use for public supply is

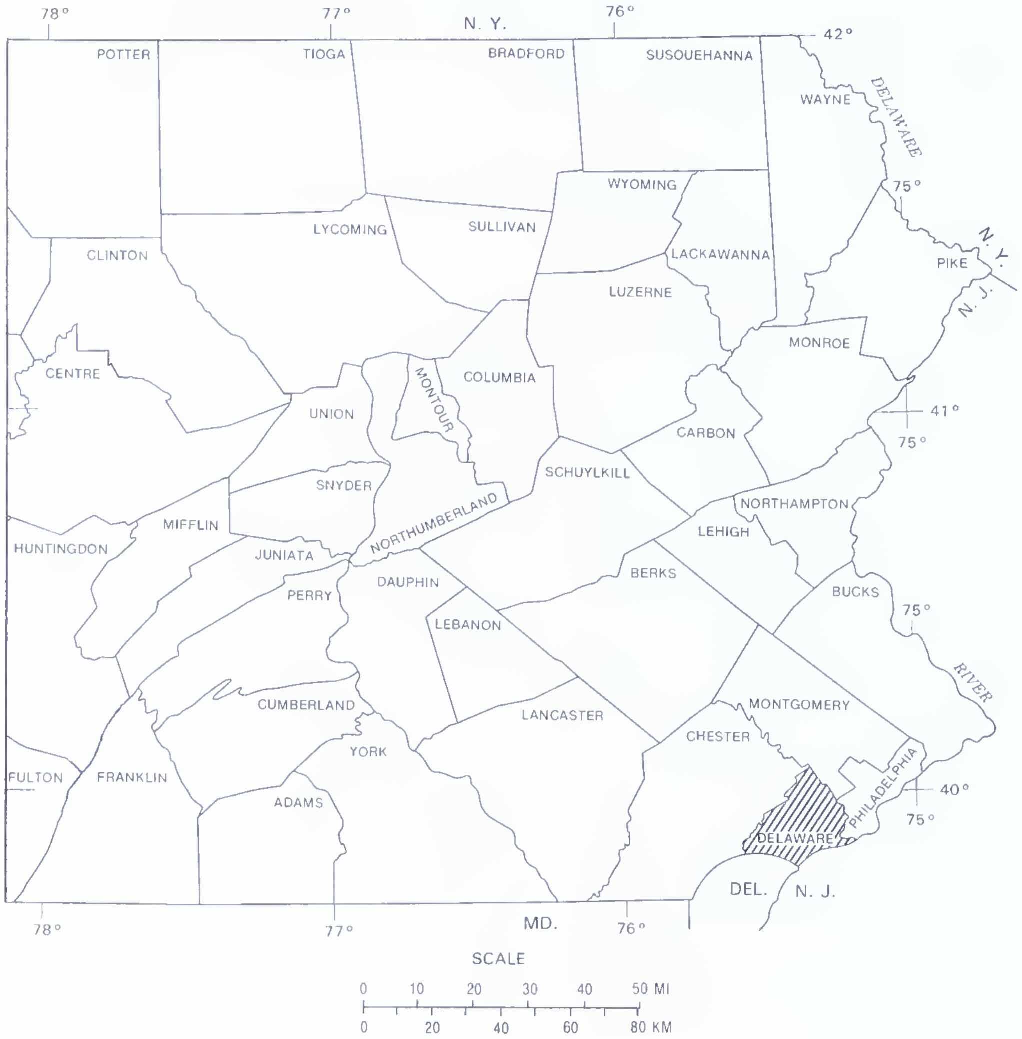


Figure 1. Location of Delaware County.

small. In the more rural areas, homes, farms, and industries rely on wells and springs for their source of supply.

The total population was about 554,000 in 1980, averaging 3,000 people per square mile. The county is highly urbanized and industrialized in the east but is more rural in the west.

PREVIOUS INVESTIGATIONS

The groundwater resources of Delaware County have been previously studied only in small areas of the county or as part of regional summaries.

Bascom and others (1909) prepared a geologic atlas of the Norristown, Germantown, Chester, and Philadelphia quadrangles that includes text descriptions of the geologic formations. Hall (1934) discussed groundwater in Delaware County as part of his reconnaissance report on southeastern Pennsylvania. Barksdale and others (1958) discussed groundwater resources in the tri-state region adjacent to the Delaware River. Olmsted and Hely (1962) described the relation between groundwater and surface water in the Brandywine Creek basin of Pennsylvania. Water resources for the entire Delaware River basin were summarized by Parker and others (1964). Poth (1968) appraised the hydrogeology of the crystalline rocks of part of northern Delaware County. Owens and Minard (1979) discussed the Bridgeton Formation and the informally named Trenton gravel of the Atlantic Coastal Plain.

WELL-NUMBERING SYSTEM

The well-numbering system used in this report consists of a county abbreviation followed by a sequentially assigned number. A well having the prefix "De" is located in Delaware County. The wells are listed in numerical sequence in Table 40, and their locations are shown on Plate 1. Gaps in the sequential numbering in the well table reflect a lack of complete records for wells not listed.

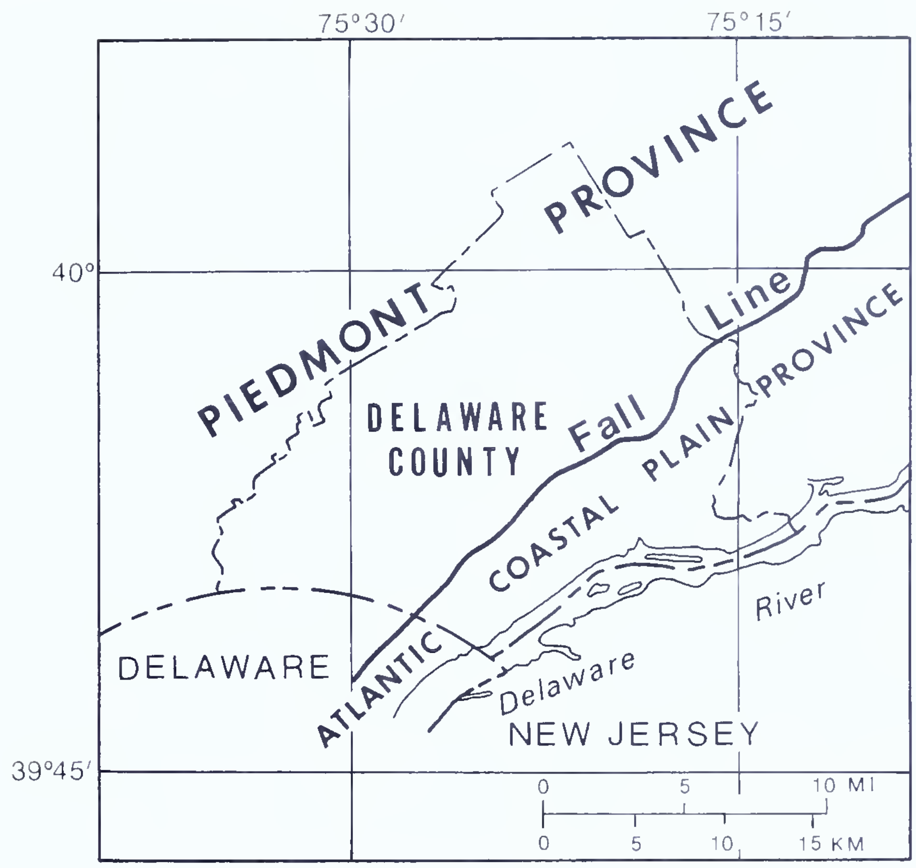


Figure 2. The physiographic setting of Delaware County.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the cooperation of the homeowners, private industries, municipalities, and state and federal agencies who supplied information and granted access to their properties for the collection of data essential to this study.

GEOHYDROLOGY

GEOLOGIC SETTING

The principal geologic units of Delaware County are of Proterozoic, early Paleozoic, Mesozoic, Tertiary, and Quaternary age and are shown on Plate 1. Table 1 contains a brief description of selected units.

Crystalline Rocks

The Proterozoic and lower Paleozoic crystalline bedrock consists of gneiss, schist, and other metamorphic rocks. These rocks belong to different geologic terranes that formed separately before being joined to southeastern Pennsylvania by accretion. The complexity of the geology makes age determination difficult for some of the units (see Plate 1). Because the focus of this report is on the hydrologic characteristics of the rock units, crystalline rocks having similar hydrologic characteristics are grouped together as follows for purposes of discussion.

Major crystalline aquifers:

(1) Mafic gneiss—Proterozoic and lower Paleozoic mafic (hornblende-, pyroxene-bearing) gneiss.

(2) Granodioritic and felsic gneiss—Proterozoic and lower Paleozoic felsic (feldspar-bearing) gneiss, granodioritic gneiss, and granite.

(3) Wissahickon Formation—schist and some gneiss.

Minor crystalline aquifers:

(1) Ultramafite—lower Paleozoic metamorphic rock derived from the alteration of ferromagnesian silicate minerals such as pyroxene and olivine.

(2) Anorthositic gneiss—lower Paleozoic plagioclase-feldspar-bearing metamorphosed igneous rock.

Numerous other rock units crop out in Delaware County but are too limited in areal extent to be considered important as aquifers. These include the following units:

(1) Jurassic diabase, commonly present as dikes and sills.

(2) Cambrian and Ordovician Conestoga Formation (limestone and some phyllite, mica schist, and limestone conglomerate).
(3) Cambrian Chickies Formation (quartzite, quartz schist, slate, and conglomerate).
(4) Lower Paleozoic or Proterozoic Z metadiabase and pegmatite.
(5) Lower Paleozoic or Proterozoic Z Cockeysville Marble.
(6) Octoraro Formation (phyllite), found in a small area at the northern tip of the county. It underlies less than 1 percent of the county.

The most extensive rock unit is the Wissahickon. This formation is predominant throughout the eastern half of the county. There are additional outcrops in the southwestern corner of the county. The Wissahickon Formation crops out over approximately 34 percent of the county and also underlies most of the unconsolidated sediments.

The granodioritic and felsic gneiss units are located mostly in the western and northern parts of the county. They underlie approximately 28 percent of the county. The mafic gneiss units are located mostly in two large areas in the southern and northern parts of the county; many smaller areas are intermingled with the felsic gneisses. Mafic gneiss underlies approximately 11 percent of the county.

Ultramafite predominates in two large areas in the central part of the county and is present as lenses in the granodioritic and felsic gneisses and the Wissahickon Formation. Ultramafite underlies approximately 4 percent of the county.

Anorthositic gneiss is present mostly in a single large area near the border between the county and the state of Delaware. It is also present in smaller areas. Anorthosite underlies approximately 2 percent of the county.

Additional information on these specific geologic units is presented in the section "Major Water-Bearing Formations."

Table 1. *Descriptive Geologic Column and Water-Bearing Characteristics of Selected Delaware County Rock Units*

System or erathem	Geologic unit	Water-bearing characteristics[1]
Quaternary	Trenton gravel (informal usage) (Qt)	Yield range: 8.0–200 gal/min Yield median: 50 gal/min
Tertiary	Bridgeton Formation (Tb)	Not important as a water-bearing formation.
	Bryn Mawr Formation (Tbm)	Not important as a water-bearing formation.
Probably lower Paleozoic and/or Proterozoic Z	Anorthositic gneiss (wan)	Yield range: 1.0–35 gal/min
	Granodioritic and felsic gneiss (gr, Ybfa, Ybfg)	Yield range: 0–100 gal/min Yield median: 10 gal/min Generally soft to moderately hard water.
	Wissahickon Formation (wb, wp)	Yield range: 1.0–300 gal/min Yield median: 20 gal/min Highest yielding crystalline aquifer in county. Generally soft to moderately hard water.
	Mafic gneiss (wbma, wma, pma, Ybma, Ybmg)	Yield range: 0.5–150 gal/min Yield median: 6 gal/min Generally soft to moderately hard water.
	Ultramafite (wum)	Yield range: 2.0–60 gal/min Yield median: 18 gal/min Moderately hard to very hard water.

[1]Definitions for hardness are given on page 24 and in the glossary.

Unconsolidated Deposits

Unconsolidated deposits overlie the bedrock in approximately 20 percent of the county; they are present mostly in the eastern part bordering the Delaware River. They consist of high-level terrace deposits of Tertiary age, and Quaternary outwash and alluvium deposited on the Atlantic Coastal Plain.

The terrace deposits lie unconformably on crystalline metamorphic rocks. The highest terrace deposits are believed to be Tertiary (Pliocene?) in age and commonly are referred to as the Bryn Mawr Formation (Bascom, 1925). These deposits generally are present at elevations above 300 feet and are less than 20 feet thick.

Terrace deposits between elevations of about 100 feet and 220 feet, some of which were mapped as Pensauken Formation by earlier workers, are assigned to the Bridgeton Formation (Owens and Minard, 1979, p. D13). These deposits are generally less than 20 feet thick. Owens and Minard (1979, p. D18) assigned a late Miocene age to them.

The most recent unconsolidated deposit is the informally named Trenton gravel, which occurs on the Atlantic Coastal Plain. Owens and Minard (1979, p. D38) assigned the Trenton gravel a Sangamonian age. Elevations range between sea level and about 40 feet near the Delaware River estuary and 150 feet further upstream on the tributaries. The thickness of the Trenton gravel generally is less than 20 feet, although it may be as much as 50 feet locally.

The Trenton gravel generally overlies the Wissahickon Formation, except in the extreme northeastern corner of the Delaware County part of the Atlantic Coastal Plain, where it overlies the Cretaceous Raritan Formation. Although the Raritan Formation is about 100 feet thick in this area and is a very high-yielding aquifer, it is not described in this report because (1) it does not crop out in Delaware County, (2) it has not been tapped by wells in the county, and (3) it thins rapidly to the southwest and is present under a very small area of the county.

All of the unconsolidated deposits are discontinuous. The Bridgeton and Bryn Mawr Formations are unimportant as water-bearing formations. They do, however, provide additional recharge and storage for the crystalline rocks beneath them. In this report, data for wells in unconsolidated deposits refer exclusively to the Trenton gravel. Lithologic and hydrologic information for the Trenton gravel is given in the section "Major Water-Bearing Formations."

HYDROLOGY

A network of 13 observation wells (Figure 3) was established to collect water-level data for all of the geologic units. These data were used to show water-level fluctuations and, in conjunction with surface-water data, to determine a relation between groundwater and surface water.

Streamflow data were obtained from the stream-gaging stations shown in Figure 3. All analyses of streamflow are based on records for water years (October 1 through September 30) unless otherwise noted. Precipitation and temperature data are from the National Oceanic and Atmospheric Administration (NOAA) stations at Chadds Ford, Marcus Hook, and Philadelphia Airport. Precipitation, temperature, and streamflow data were used to calculate base flow, evapotranspiration, and groundwater discharge to streams. Dry, normal, and wet years, used in hydrologic analyses, were selected based on precipitation data from these stations.

Groundwater

Occurrence

The usefulness of a rock unit as a water-bearing formation depends on the characteristics and structural properties of the rock. Rocks near the surface of the earth are composed of solids (grains) and voids. Voids in the rock consist of intergranular spaces (primary porosity) or joints and fractures (secondary porosity), as shown in Figure 4. Groundwater is present in and moves only through these voids. Most of the water in the consolidated rocks is present in and moves through secondary openings. Primary porosity is found only in the Tertiary and Quaternary deposits and in the weathered zone above consolidated rocks. The groundwater reservoir is the saturated zone below the land surface.

Most groundwater moves from recharge areas, where precipitation infiltrates the ground on uplands and hillsides, to nearby valleys, where it discharges to streams. Streams in the county generally act as drains for the groundwater reservoir. Although deep interbasin groundwater flow may occur, it is probably negligible in this geohydrologic setting.

Recharge

The groundwater recharge to a basin is equal to the base flow of streams draining it if the storage is constant and consumptive use is negligible. Groundwater recharge rates were calculated from hydrograph separations for the Chester, Darby, and Cobbs

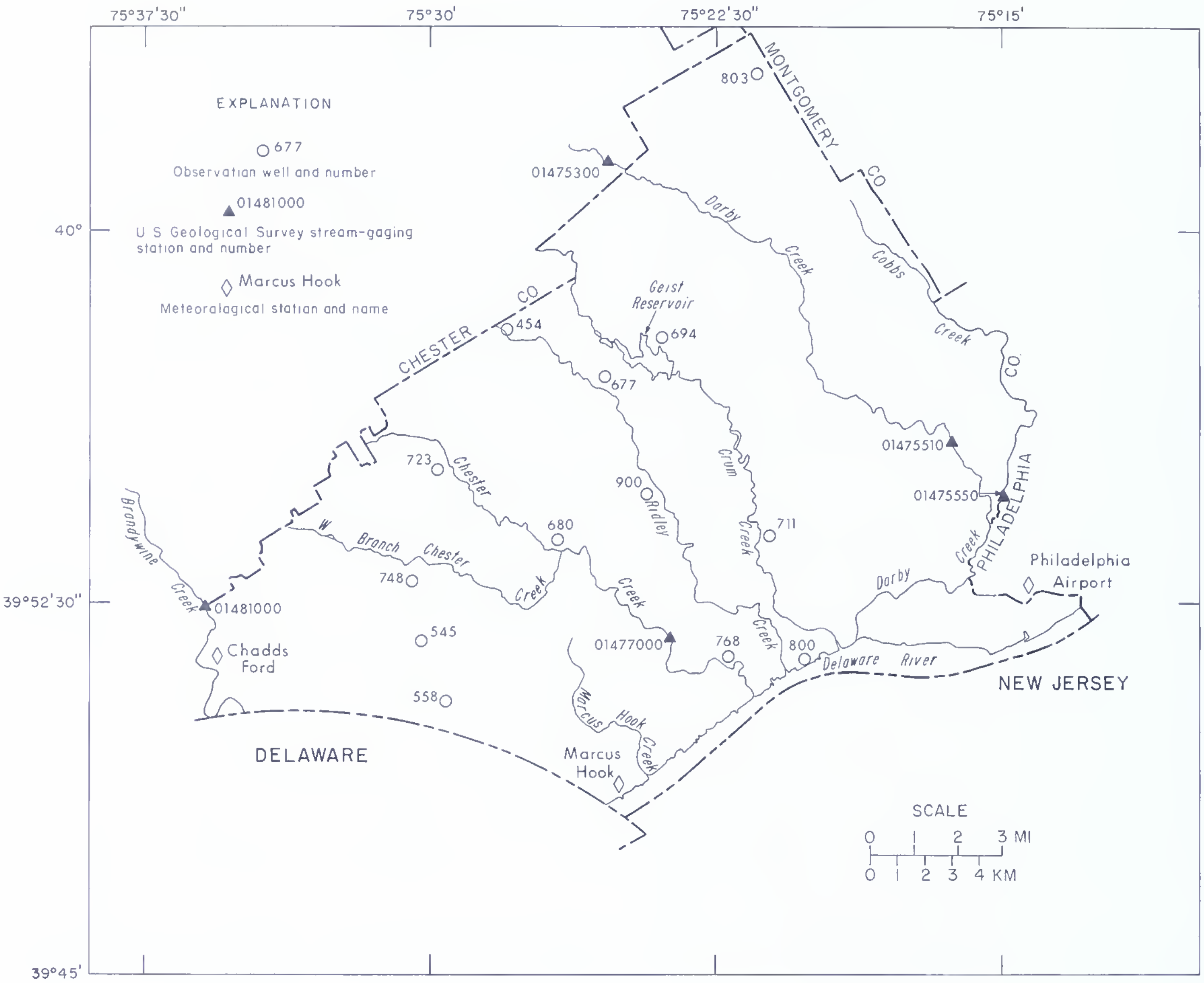


Figure 3. Major streams, stream-gaging stations, meteorological stations, and observation wells in Delaware County.

Creek basins. The Chester and Darby Creek basins lie in Delaware and Chester Counties. The Cobbs Creek basin is highly urbanized in parts of Delaware, Montgomery, and Philadelphia Counties. Dry, wet, and normal years were selected based on the driest and wettest years and the year most closely resembling the 30-year precipitation normal for the three precipitation stations. Recharge rates are given in thousands of gallons per day per square mile in Table 2. The average recharge rate for Delaware County is estimated to be 684,000 (gal/d)/mi^2 (gallons per day per square mile).

Table 2 shows that wetter years have larger recharge rates, although the increase in recharge is not directly proportional to the increase in discharge or precipitation. Cobbs Creek basin, the most highly urbanized area, has the least amount of recharge of the three basins. Recharge rates for the two gages on Darby Creek were calculated for the corresponding areas of the basins measured by each gage. The upper reach of Darby Creek had a greater recharge rate than the entire basin, probably because urbanization is low in the upper reach.

Weathering

The weathering process is a mechanical and chemical breakdown of rock by the actions of air, water, temperature variations, and biological activity. The process is most intense near the land surface and usually decreases as depth increases. The top of consolidated rock is the lower limit of the weathered zone. Below this zone the rock is generally solid, but some weathering extends farther, particularly along frac-

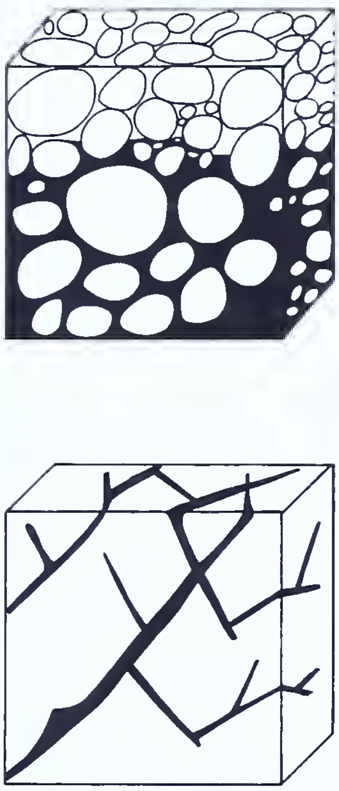


Figure 4. Schematic illustrations of primary and secondary porosity (modified from Heath, 1983).

tures. The change in the rock with depth is gradational, ranging from soil at the surface, to unconsolidated clay and bits of rock, to boulder-sized rock in a clayey matrix. The storage capacity and permeability of the weathered rock vary according to the nature of the parent rock, degree of weathering, and the filling of joints and pores by clays and chemical precipitates. Water in the weathered zone is stored in and moves through both primary and secondary openings.

Casing in drilled wells prevents loose material from collapsing into the borehole. The loose material consists of unconsolidated deposits or the soil and rock fragments that comprise the weathered zone above solid bedrock, so that the casing is commonly set a few feet into solid bedrock. As a result, the depth of the weathered zone can be estimated, but not determined precisely, from casing depth. Depth of casing and median depth to water are given in Table 3. The median depth of weathering in most units is about 40 feet. Ultramafite, which is very resistant to chemical weathering, has a median depth of well casing of about 60 feet and is an anomaly to the above method of estimation of the weathered zone. This median depth of well casing probably reflects the softness of the rock rather than the depth of the weathered zone.

Storage

The groundwater reservoir consists of water stored in the saturated zone. Because groundwater discharges to streams, groundwater withdrawals will reduce base flow. All withdrawals lower local groundwater levels. Excessive withdrawals may lead to extensive lowering of levels and the depletion of the groundwater reservoir.

The weathered zone and the unconsolidated deposits are important because they contain a major percentage of the water in storage. Specific yield (the ratio of water that will drain from a volume of rock or soil under the force of gravity to the volume of rock or soil) of the unconsolidated deposits was estimated by Barksdale and others (1958, p. 163) to be 30 percent. This figure was used to calculate the storage of water in unconsolidated deposits in the county. Olmsted and Hely (1962, p. 18) estimated a specific yield of the weathered zone as 7.5 to 10 percent. A conservative estimate of 8 percent for the specific yield of the weathered zone is used in this report. The average saturated thickness of the weathered zone was estimated from the median depth of well casing minus the median depth to water (Figure 5 and Table 3). Based on data for 282 wells, the average estimated saturated thickness for all of the consolidated rock aquifers is 20 feet.

Table 2. *Recharge Rates for Darby, Cobbs, and Chester Creek Basins for Dry (1981), Normal (1976), and Wet (1979) Years*

Gaging-station name and number	Drainage area (mi^2)	Type of year	Recharge rate[1]
Darby Creek at Waterloo Mills near Devon 01475300	5.15	Dry	433
		Normal	881
		Wet	1,036
Darby Creek near Darby 01475510	37.4	Dry	334
		Normal	774
		Wet	856
Cobbs Creek at Darby 01475550	22.0	Dry	271
		Normal	428
		Wet	698
Chester Creek near Chester 01477000	61.1	Dry	387
		Normal	653
		Wet	940
Average of above stations		Dry	356
		Normal	684
		Wet	892

[1]Thousands of gallons per day per square mile.

Table 3. *Median Depth of Well Casing, Median Depth to Water, and Estimated Saturated Thickness of the Weathered Zone for Consolidated Rock Units in Delaware County*

Geologic unit	Number of wells	Median well casing depth or range (feet)	Median depth to water or range (feet below land surface)	Estimated saturated thickness of the weathered zone (feet)
Anorthositic gneiss	6	20–31	7.1–35	10
Granodioritic and	129	40	—	12
felsic gneiss[1]	134	—	29	—
Mafic gneiss[1]	54	40	—	15
	53	—	25	—
Ultramafite	8	62	20	43
Wissahickon Formation[1]	114	40	—	20
	112	—	20	—

[1]One set of wells was used to determine well casing depth and saturated thickness, and a different set was used to determine depth to water.

Storage also occurs in fractures in the upper 300 feet of the consolidated crystalline rocks. These fractures, which serve mainly as pathways for water to move through the rock, have a low storage capacity. The estimated specific yield for this zone is 0.2 percent (McGreevy and Sloto, 1977, p. 33). The approximate volume of water in storage per unit area can be calculated using the above estimates of specific yield and average saturated thickness; total storage is storage per unit area times area:

	Storage (feet of water)[1]	Area (square miles)	Total storage (million gallons)
Weathered zone of consolidated rocks	1.6	143.5	47,900
Unconsolidated units[2]	4.5	36.5	34,300
Unweathered zone of consolidated rocks	.6	180	22,500
Total			104,700

[1]Cubic feet of water per square foot of aquifer.
[2]Includes any water stored in the weathered zone of consolidated rocks beneath the unconsolidated units.

Thus, the average amount of water in storage for the entire county is about 2.5 feet (30 inches).

Groundwater Levels

The groundwater system in Delaware County is dynamic. The groundwater level is constantly rising and falling as a result of various stresses affecting this system, such as climatic conditions and withdrawals. Water levels have a seasonal trend, generally rising during the nongrowing season (winter and early spring), when evapotranspiration is low, and declining during the growing season (late spring, summer, and early fall), when evapotranspiration is high. Hydrographs for two wells, De–800 and De–748, are shown in Figure 6. Well De–800 is in the Wissahickon Formation and is on the floodplain of the Delaware River. Well De–748 is on a hillside in the felsic gneiss near an unnamed tributary to Chester Creek. These hydrographs show the variation in seasonal water-level fluctuation and the typical range of fluctuation.

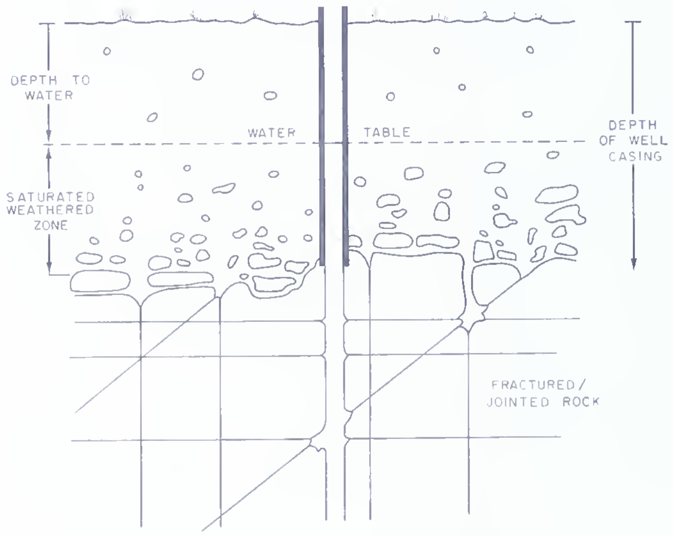


Figure 5. The saturated thickness of the weathered zone, estimated by subtracting the depth to water from the depth of well casing (illustration modified from McGreevy and Sloto, 1977).

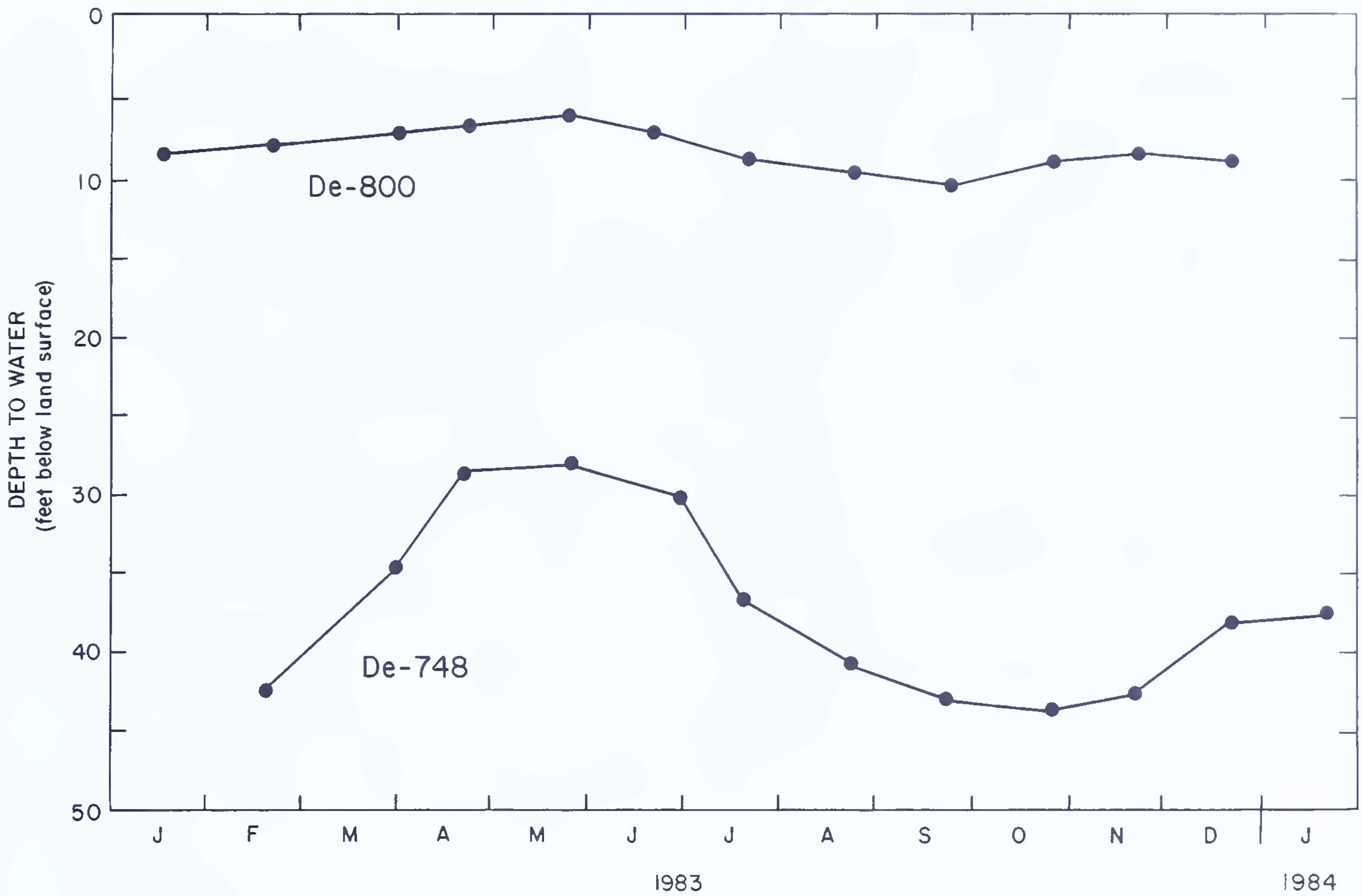


Figure 6. Hydrographs illustrating water-level fluctuation in two wells from January 1983 to January 1984. Well De–800 is in the Wissahickon Formation on the floodplain of the Delaware River. Well De–748 is in felsic gneiss on a hillside near a tributary of Chester Creek.

The amplitude of water-level fluctuation depends on several conditions. A comparison of well locations and annual water-level fluctuations is given in Table 4. Wells in a floodplain or close to a stream or discharge point generally tend to have small seasonal variations and shallow depths to water. Wells distant from a stream generally have high seasonal fluctuations and greater depths to water (Figure 7).

The water table near the Delaware River estuary fluctuates in response to tides. The amplitude of these fluctuations decreases with distance from the estuary. In a well, tidal fluctuation is induced by the change in hydraulic gradient of the water table caused by the change in river level during the tidal cycle. There is a time lag between the cycles in the estuary and the cycles in the aquifer; this time lag increases with distance from the estuary. Tidal effects are most pronounced in the unconsolidated deposits, which can transmit gradient changes over long distances because of high hydraulic conductivity (the ability of a rock to transmit water). Wells in the unconsolidated deposits in close proximity to the Delaware estuary that show a strong tidal influence may be susceptible to saltwater encroachment during heavy pumping.

Surface Water

Four of the major streams in Delaware County drain directly to the Delaware River; these are Darby, Ridley, Crum, and Chester Creeks. Cobbs Creek is a tributary to Darby Creek. Darby and Cobbs Creeks are not used as a source of water supply in Delaware County because of limited quantity and poor quality, the latter term signifying water that is unsuitable for human consumption and most other uses. Two municipal wastewater treatment plants that discharge into tributaries of Chester Creek upstream of Delaware County significantly reduce its quality. In 1983, the dissolved mercury concentration measured at East Branch Chester Creek below Goose Creek near West Chester in Chester County (gaging station 01476848) was 110 μg/L (the U.S. Environmental Protection Agency [USEPA] recommended limit for drinking water is 2 μg/L), and the dissolved nitrate as nitro-

Table 4. *Comparisons of Well Locations With Annual Water-Level Fluctuations*

Well number	Geologic unit	Topographic location	Range (feet)	Water level High (feet below land surface and month)	Water level Low (feet below land surface and month)
De–800	Wissahickon Formation	Floodplain along the Delaware River	4.21	6.06 May	10.27 Sept.
711	Mafic gneiss	Floodplain of Crum Creek	4.31	4.80 May	9.11 Aug.
545	Wissahickon Formation	Hilltop near tributary to South Creek	5.64	21.38 June	27.02 Nov.
803	do.	Lower hillside near Gulph Creek	6.86	39.11 Apr.	45.97 Aug.
558	Mafic gneiss	Hillside near West Branch of Naaman Creek	7.98	25.34 May	33.32 Nov.
680	Felsic gneiss	Hilltop near Chester Creek	11.33	21.90 Apr.	33.23 Sept.
748	do.	Hillside near tributary to Chester Creek	15.47	28.12 May	43.59 Oct.

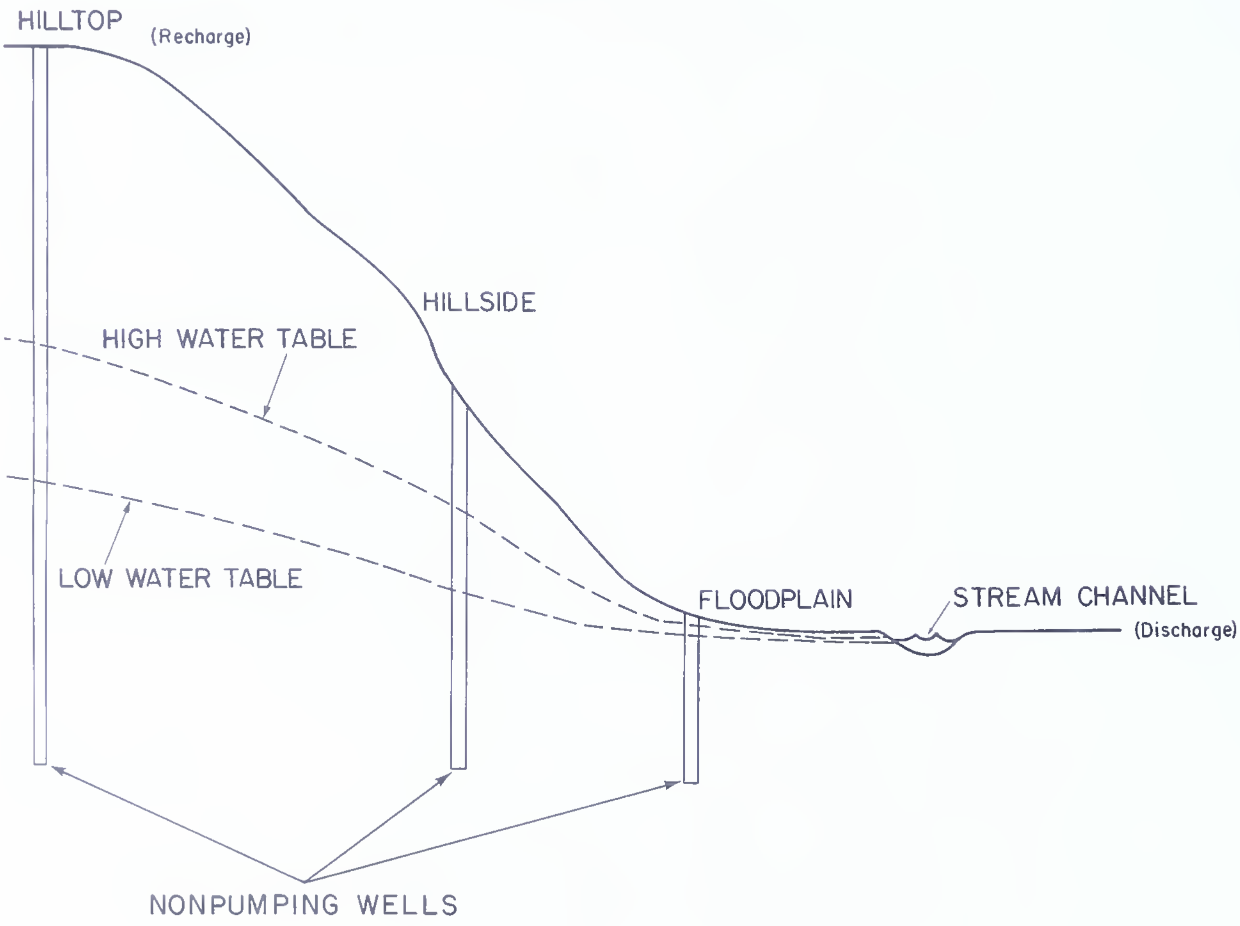


Figure 7. Variability of the water table with distance from point of discharge.

gen concentration was 27 mg/L (the USEPA recommended limit is 10 mg/L). Many industries and institutions, as well as the boroughs of West Chester and Downingtown and the city of Coatesville, discharge wastewater into Brandywine Creek. Based on weekly samples, fecal coliform bacteria concentrations exceeded the criteria for drinking water 100 percent of the time in 1983. Downstream from Delaware County, Brandywine Creek supplies the city of Wilmington, Del., and its surrounding area.

Discharge

Streamflow is a combination of direct runoff from precipitation and base flow. Base flow is groundwater discharge to streams. Streamflow data are available for at least 10 years of record for the five gaging stations shown in Figure 3. The length of record for each station is listed in Table 5. Discharge hydrographs were separated into base flow and direct-runoff components for the period of record for the following stations: Darby Creek at Waterloo Mills near Devon (01475300), Darby Creek near Darby (01475510), Cobbs Creek at Darby (01475550), Chester Creek near Chester (01477000), and Brandywine Creek at Chadds Ford (01481000). Hydrograph separations were done using a model by Pettyjohn and Henning (1979). Table 6 shows comparisons between the streamflow (discharge) and base flow of the five stations. The data in Table 6 are useful in evaluating streams as a potential water supply. The more consistent the base flow remains during various conditions and the higher the proportion of base flow to streamflow, the more reliable the stream is as a water source. Cobbs Creek has the lowest ratio of base flow to streamflow of the five streams. A lower ratio probably is caused by increased direct runoff from storm sewers in highly urbanized areas. The high amount of impervious surface in such an area causes more precipitation to become direct runoff and less to become groundwater recharge. Therefore, less water is available to be discharged as base flow. The gages in more rural settings, Darby Creek at Waterloo Mills near Devon and Brandywine Creek at Chadds Ford, show higher ratios of base flow to streamflow than the gages in more urban areas.

Table 7 shows a comparison of the precipitation, total discharge, and base-flow discharge at the two stream gages on Darby Creek for 1973 through 1982. Streamflow data for Darby Creek show a lower percentage of base flow at the downstream station (Darby Creek near Darby) than at the upstream station (Darby Creek at Waterloo Mills near Devon), which drains a more rural area. Possible reasons for the lower percentage of base flow are more rainfall in the upper part of the basin and more direct runoff because of urbanization in the lower part of the basin.

Flow Duration

Differences in physical characteristics and climatic conditions of basins will cause differences in streamflow. The variability and magnitude of streamflow are dependent upon variables such as basin size, slope, shape, elevation, geology, ground cover, and stream density, as well as climatic conditions. These differences can be shown by flow-duration curves of the streamflow. A flow-duration curve shows the percentage of time a rate of discharge is expected to be equaled or exceeded during a given period.

The shape of the flow-duration curve reflects the characteristics of the drainage basin. The high-flow

Table 5. *Lengths of Records for Stream-Gaging Stations*

Gaging-station name	Gaging-station number	Drainage area (mi^2)	Years of record	Period of record (water years)
Darby Creek at Waterloo Mills near Devon	01475300	5.15	22	1973–94
Darby Creek near Darby	01475510	37.4	26	1965–90
Cobbs Creek at Darby	01475550	22.0	26	1965–90
Chester Creek near Chester	01477000	61.1	63	1932–94
Brandywine Creek at Chadds Ford	01481000	287	74	1912–53 1963–94

Table 6. Summary of Discharge and Base Flow for Dry (1981), Normal (1976), and Wet (1979) Years

Gaging-station name and number	Type of year	Discharge (inches)[1]	Base flow (inches)[1]	Discharge from groundwater (percentage of total discharge)
Darby Creek at Waterloo Mills near Devon 01475300	Dry	14.33	9.10	63
	Normal	22.98	18.51	81
	Wet	37.61	21.77	58
Darby Creek near Darby 01475510	Dry	13.27	7.02	53
	Normal	22.64	16.27	72
	Wet	33.05	17.99	54
Cobbs Creek at Darby 01475550	Dry	15.15	5.70	38
	Normal	17.54	9.00	51
	Wet	29.54	14.66	50
Chester Creek near Chester 01477000	Dry	14.01	8.13	58
	Normal	19.91	13.73	69
	Wet	37.38	19.75	53
Brandywine Creek at Chadds Ford 01481000	Dry	9.41	6.40	68
	Normal	19.78	14.71	74
	Wet	32.57	18.47	57

[1]Cubic inches of water per square inch of basin area.

end of the curve is related to climate, topography, and land cover (runoff features), whereas the low-flow end (base flow) is related to the geology of the basin. A curve that is steep throughout indicates the flow of a highly variable stream that is characterized by much direct runoff. A flat curve indicates the availability of enough surface-water or groundwater storage in the basin to moderate streamflow.

Table 7. Comparison of Precipitation, Total Discharge, and Base-Flow Discharge for Darby Creek at Waterloo Mills Near Devon and Darby Creek Near Darby, 1973–82

	Darby Creek at Waterloo Mills near Devon (Gaging station 01475300)				Darby Creek near Darby (Gaging station 01475510)			
		Groundwater				Groundwater		
			Base-flow discharge				Base-flow discharge	
Year	Precipitation[1] (inches)	Total discharge (inches)[2]	(inches)[2]	(percentage of total)	Precipitation[3] (inches)	Total discharge (inches)[2]	(inches)[2]	(percentage of total)
1973	52.14	33.76	23.17	69	46.06	36.57	21.91	60
1974	41.00	23.40	16.63	71	37.78	25.01	16.71	67
1975	56.86	28.75	19.53	68	52.13	30.27	19.22	63
1976	38.09	22.98	18.51	81	33.27	22.64	16.27	72
1977	50.89	17.85	12.41	68	49.42	16.59	9.68	58
1978	49.23	36.72	22.96	62	35.58	31.37	18.44	59
1979	64.34	37.61	21.77	58	52.79	33.05	17.99	54
1980	34.89	23.12	17.46	76	38.80	20.83	14.77	71
1981	42.37	14.33	9.10	63	37.83	13.27	7.02	53
1982	49.04	20.54	13.24	64	40.43	20.26	11.77	58
Mean	47.89	25.91	17.48	68	42.41	24.99	15.38	62

[1]Precipitation measured at the Devault and Conshohocken stations.
[2]Cubic inches of water per square inch of basin area.
[3]Precipitation measured at the Philadelphia Airport.

Figure 8 shows flow-duration curves for four streams in Delaware County. Discharge is given in units of cubic feet per second per square mile of drainage basin. Comparison of runoff on this basis eliminates basin size as a factor, thereby better demonstrating the combined influences of climate, geology, topography, and man-made structures on streamflow. Cobbs Creek near Darby has the lowest discharge per square mile of these four streams. As Darby Creek at Waterloo Mills near Devon has the lowest percentage of time that the higher discharges were equaled or exceeded, it has the least tendency for flash flooding. This is probably because it drains a more rural area than the other streams.

Table 8 shows the duration of daily discharge, in cubic feet per second per square mile of drainage basin. Chester Creek near Chester has the highest discharge. Part of this flow is attributable to the discharges of two municipal sewage treatment plants upstream. Their effluent largely represents groundwater withdrawals by public water suppliers in Chester County and interbasin transfers from the Ridley and Brandywine Creek basins. Cobbs Creek shows both a high frequency of high-discharge events (flash floods) and a high frequency of lower discharge when compared to the other stations, primarily because of the large impervious area caused by urbanization in the Cobbs Creek basin.

Relation Between Groundwater and Surface Water

Groundwater levels influence the surface-water base flow, thereby sustaining from 40 to 80 percent of

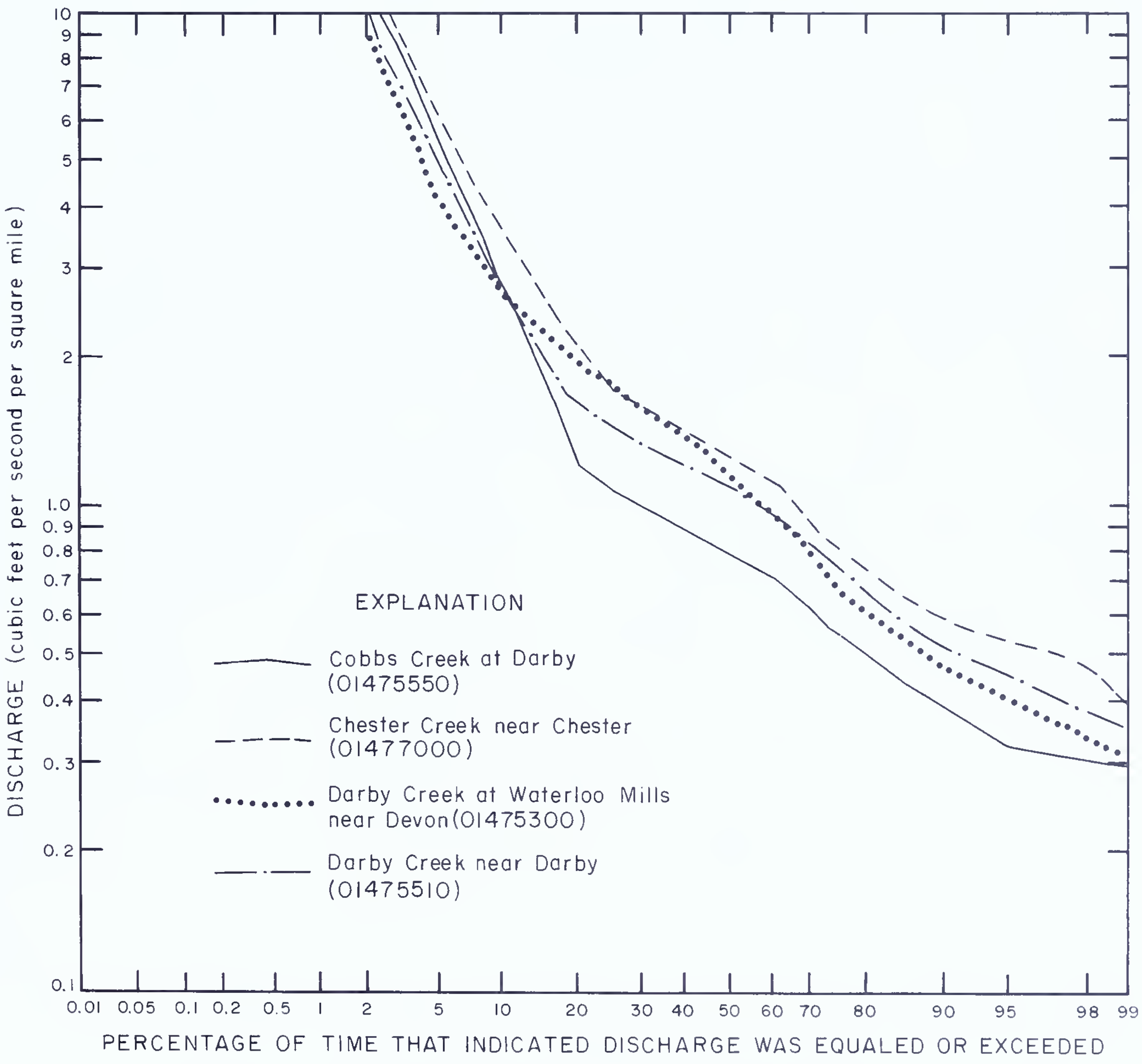


Figure 8. Flow-duration curves of daily discharge for selected streams, 1979–82.

Table 8. *Duration of Daily Discharge at Four Gaging Stations*

Gaging-station name and number	Drainage area (mi^2)	Discharge in cubic feet per second per square mile of drainage area that is equaled or exceeded for the indicated percentage of time												
		2	5	10	20	30	40	50	60	70	80	90	95	98
Darby Creek at Waterloo Mills near Devon 01475300	5.15	9.5	4.1	2.7	2.0	1.7	1.4	1.2	0.99	0.80	0.60	0.45	0.39	0.33
Darby Creek near Darby 01475510	37.4	9.8	4.4	2.8	1.7	1.4	1.3	1.1	.99	.80	.67	.48	.43	.37
Cobbs Creek at Darby 01475550	22.0	10.5	5.5	2.9	1.3	1.0	.91	.82	.73	.60	.50	.39	.31	.30
Chester Creek near Chester 01477000	61.1	11.7	5.9	3.6	2.1	1.7	1.5	1.3	1.2	.90	.70	.57	.52	.47

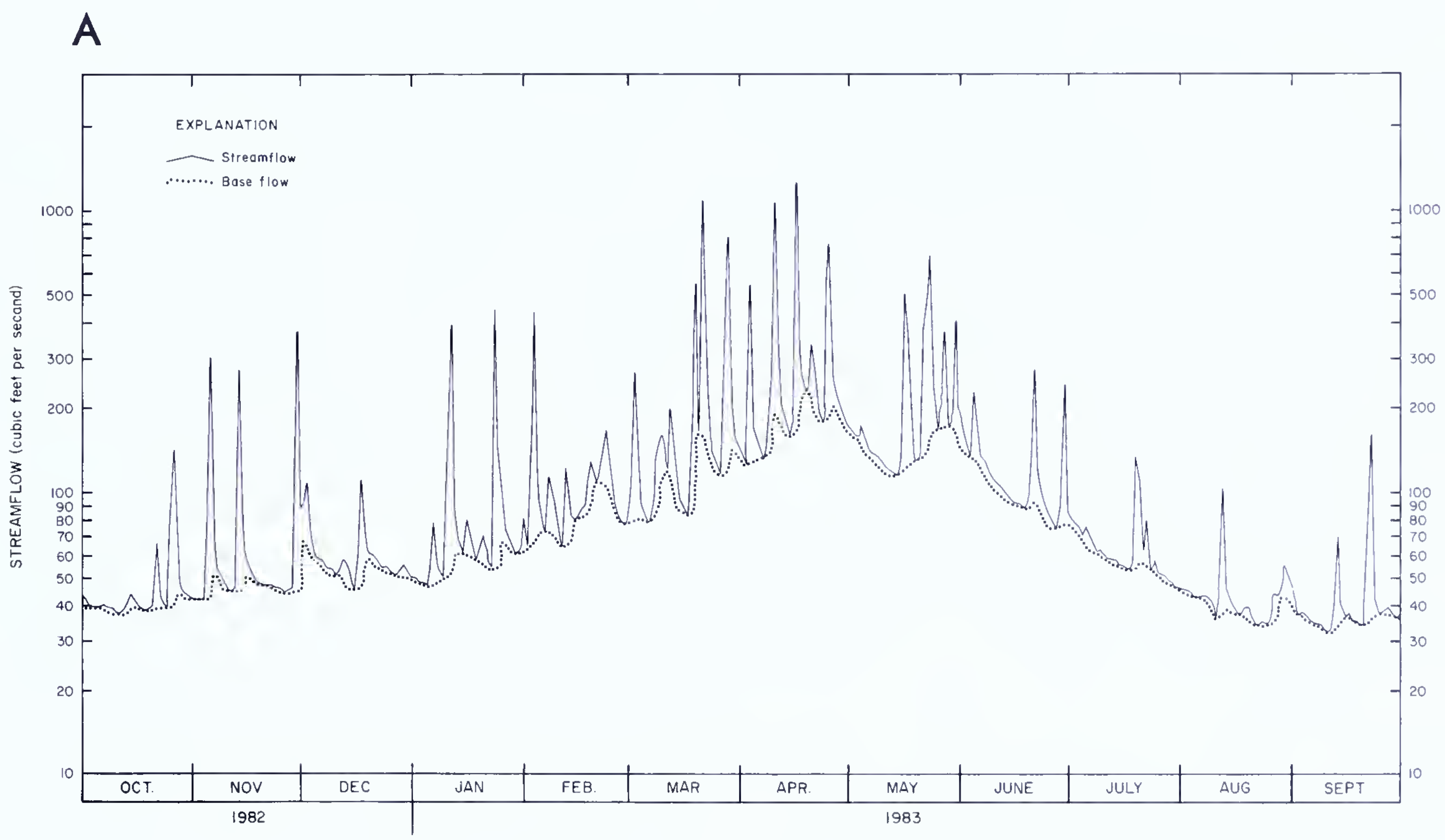
the total surface-water flow. Figure 9 shows the streamflow and base-flow hydrographs for Chester Creek near Chester for the 1983 water year and the hydrograph for well De–680 for part of the 1983 water year. Except for floods, stream stages show the same seasonal variations as groundwater levels.

Water Use

Public Water Suppliers

Almost 62 percent of the water delivered in Delaware County is imported from groundwater and surface-water sources in the adjoining counties. Three major public water suppliers and three minor ones supply the county. Supply systems of the three major water companies are interconnected. Figure 10 shows the service areas of the county's six public water suppliers. In areas outside the service areas, water is obtained from private wells. Table 9 shows the average daily water production and sources of public water supply in Delaware County.

The West Mattson Company and Castle Rock Water Association are small, publicly owned, self-supplied systems. The West Mattson Company has



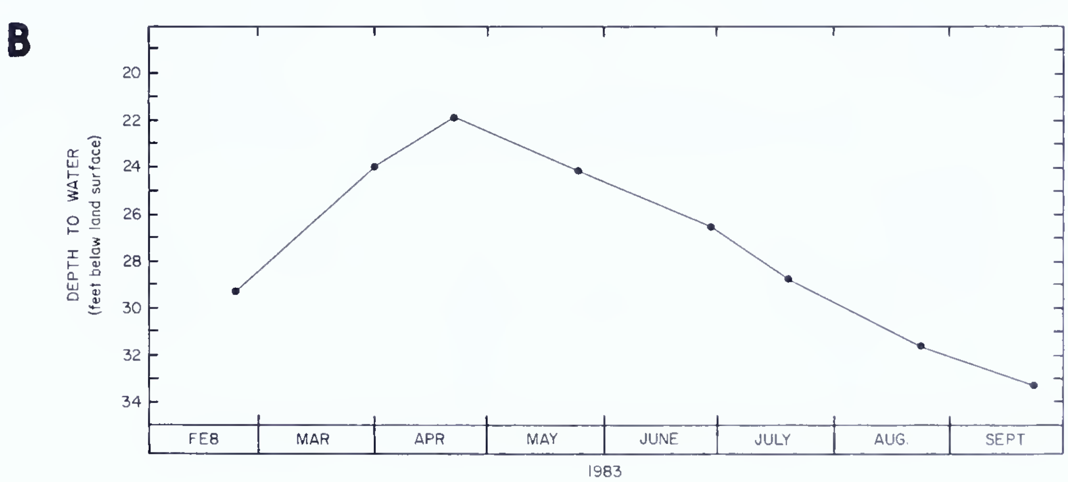


Figure 9. Hydrographs of streamflow and base flow for Chester Creek near Chester (A) and hydrograph for well De–680 (B).

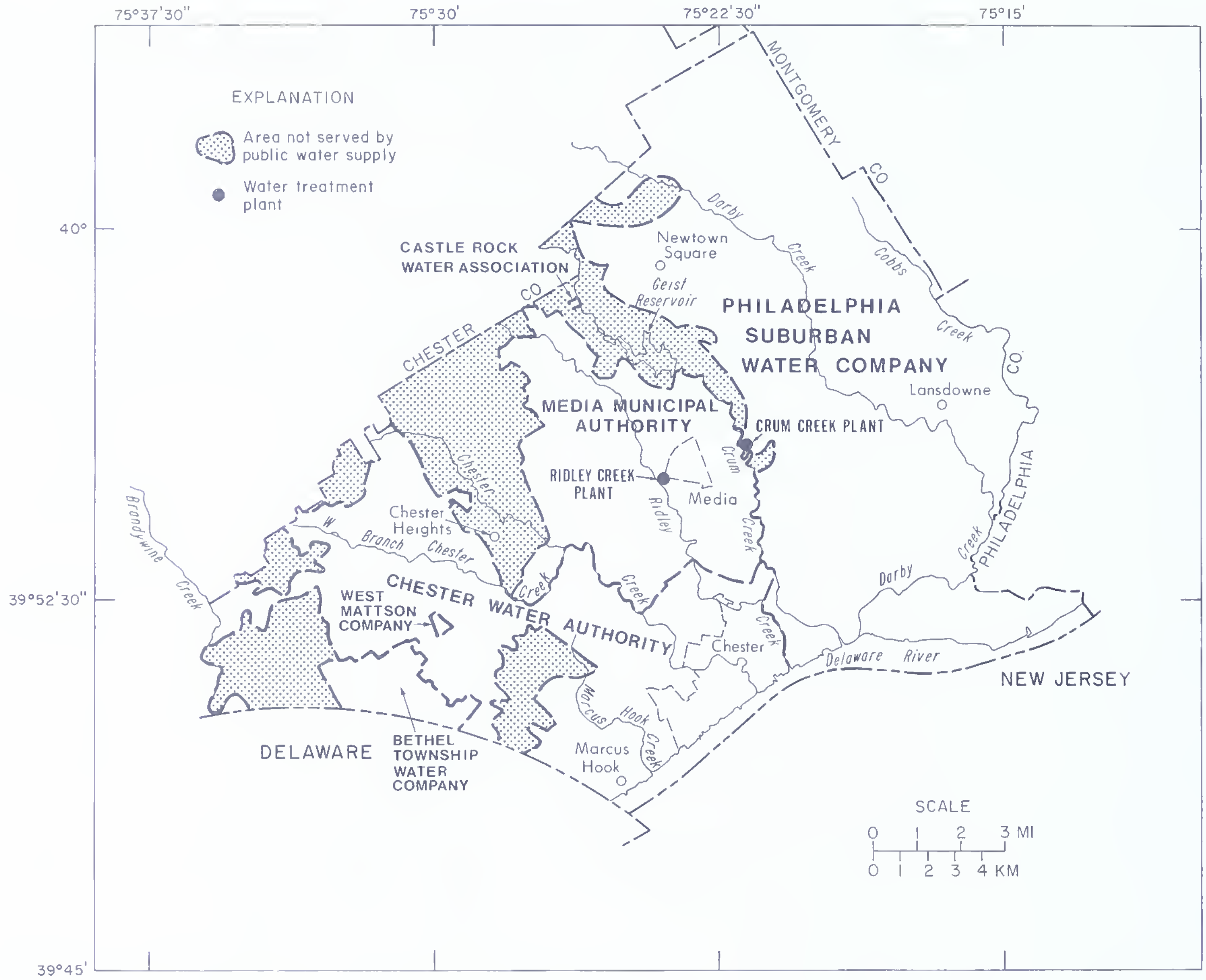


Figure 10. Areas served by public water suppliers in Delaware County.

two wells and supplies 58 connections. The Castle Rock Water Association has one well, and the water use is small but unknown. The Bethel Township Water Company obtains an average of 1.3 Mgal/d from the Chester Water Authority. It supplies only a few customers in Delaware County and transmits the remainder of the water to the Wilmington Suburban Water Corporation in Delaware.

Table 9. *Water Sources of the Public Water Suppliers in Delaware County*

Supplier	Sources	Average daily production (Mgal/d)
Bethel Township Water Company	Buys water from Chester Water Authority	1.3
Castle Rock Water Association	1 well	—[1]
West Mattson Company	2 wells	—
Chester Water Authority	Octoraro Creek (outside county)	26.5
	Susquehanna River (outside county)	.059
Media Municipal Authority	Ridley Creek, Chester Creek, and 1 well	4.5
Philadelphia Suburban Water Company	Crum Creek	20
	Pickering Creek, Perkiomen Creek, Schuylkill River, and 16 wells (all outside county)	24

[1]Dashes indicate that average daily production is unknown.

The Media Municipal Authority maintains a surface-water treatment plant on Ridley Creek near Media. This water supply is augmented by water pumped from Chester Creek to the treatment plant. In addition, the authority draws water from one well. The well produces about 0.125 Mgal/d. The authority also imports water from both the Philadelphia Suburban Water Company and the Chester Water Authority. The average sendout from the plant is about 4.5 Mgal/d; however, this fluctuates considerably according to the season. The total surface allocation of the Media Municipal Authority is 3 Mgal/d from Ridley Creek and 3 Mgal/d from Chester Creek.

The Chester Water Authority imports most of its water from a treatment plant below its impoundment reservoir on Octoraro Creek, which forms part of the boundary between Chester County and Lancaster County. To supplement the flow of the Octoraro, the authority maintains a 30 Mgal/d pumping station on the Susquehanna River. This has been used only for testing, having pumped only 21 Mgal during 1983. In 1983, the Chester Water Authority served an estimated population of 103,000 people in Delaware County. The average output of the Octoraro treatment plant was 26.5 Mgal/d; approximately 97 percent of this was supplied to Delaware County.

The Philadelphia Suburban Water Company is the largest water supplier in Delaware County, serving an estimated population of 425,000. The sole source of water within the county that is used by this company is Crum Creek; the average production from that creek is approximately 20 Mgal/d. The company's total supply to the county is about 44 Mgal/d. The additional water comes from 16 wells and a treatment plant on Pickering Creek, which draws water from Pickering Creek, Perkiomen Creek, and the Schuylkill River. These sources are in Chester and Montgomery Counties.

The populations served by public water suppliers and self-supplied through the use of private water wells are as follows:

Supplier	Source	Population
Self	Groundwater	19,587
Public	Groundwater	1,060
	Surface water	534,360
	Total	535,420

In Delaware County, 96 percent of the total population is served by public water suppliers and about 90 percent of the total population is served by public sewers.

Water Use From Sources Within the County

Reported major uses of water from sources within the county are summarized in Table 10. The largest use is thermoelectric power generation, most of which occurs in stream. Industrial use accounts for the greatest withdrawals and consumption within the county. Reported agricultural withdrawals are almost negligible.

Water Budget

Precipitation

Precipitation is the source of groundwater and surface water in Delaware County. Long-term precipitation data are available from the Philadelphia Airport station, the Chadds Ford station, and the Marcus Hook station. Figure 11 shows the annual and normal precipitation at Marcus Hook. Monthly variability can be up to one order of magnitude and is erratic. The average of the normal precipitation for the three recording stations in and near Delaware County for each month from 1951 through 1980 is shown in Figure 12. Total precipitation is nearly evenly distributed throughout the year. The average of the yearly normals for the three stations is 43.46 inches.

Table 10. *Reported Water Use From Sources Within Delaware County*

(Data from surveys conducted by Pennsylvania Department of Environmental Protection)

Source	Average daily amount (gallons)
Public-supplied domestic (1981)	
Surface water	3,990,000
Groundwater	43,610
Total	4,033,610
Consumption (estimated)	–403,361
Net return to streams	3,630,249
Industrial (1977)	
Surface water	303,508,200
Groundwater	274,430
Total	303,782,630
Consumption	–41,356,585
Net return to streams	262,426,045
Thermoelectric (1977)	
Surface water	1,410,000,000
Consumption	–2,790,000
Net release to streams	1,407,210,000
Agriculture (1977)	
Irrigation	None
Livestock	47,300

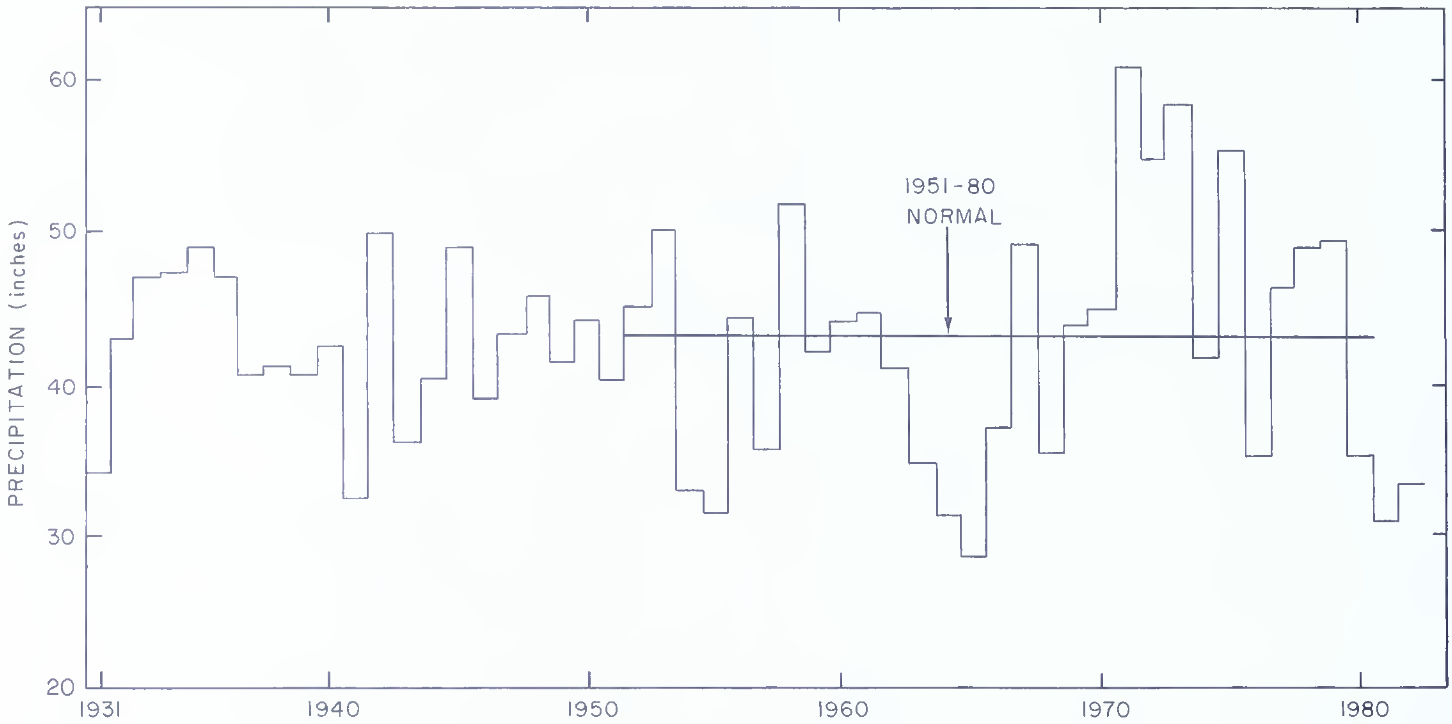


Figure 11. Annual precipitation at Marcus Hook, 1931–82, and the normal precipitation based on that recorded for 1951–80.

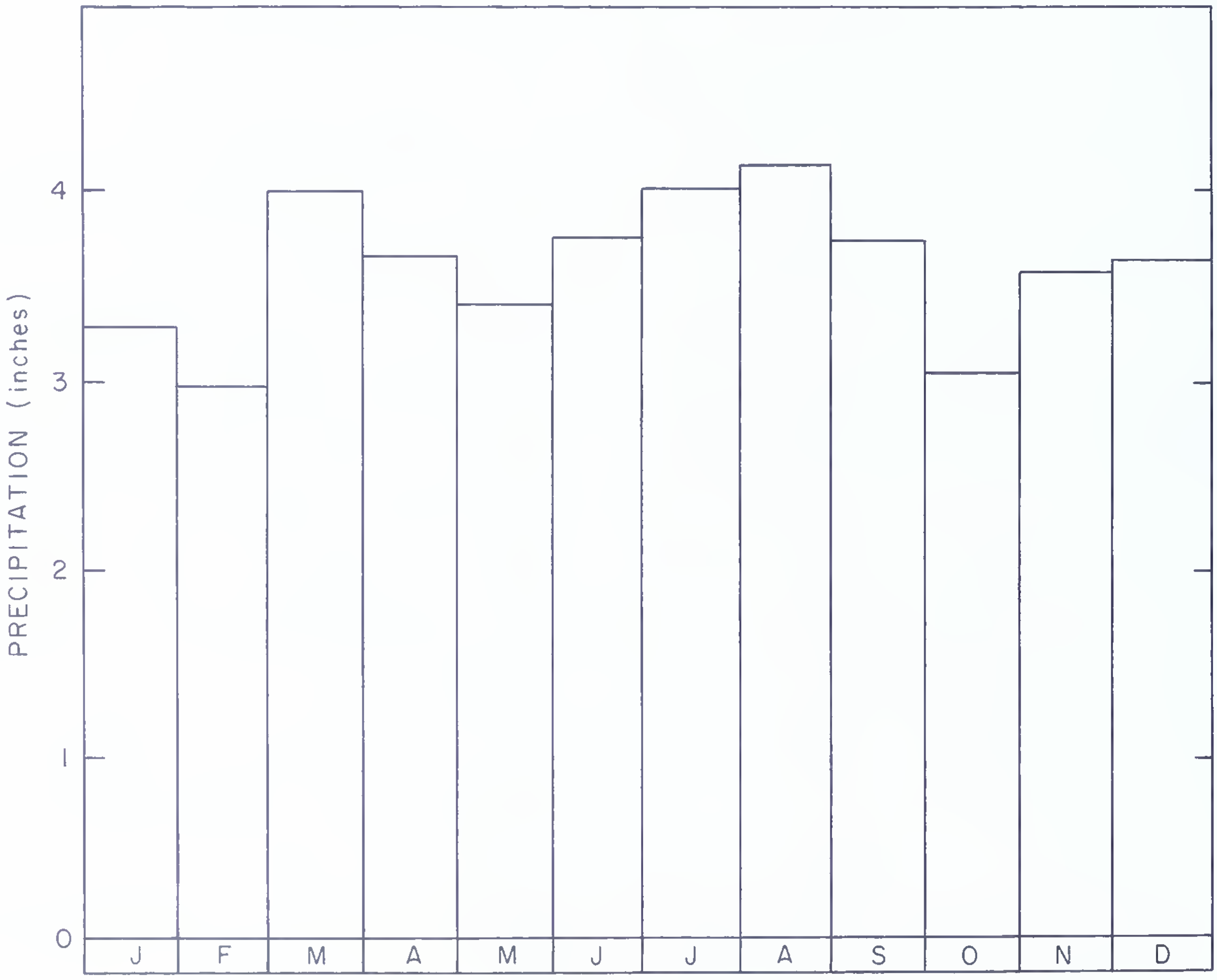


Figure 12. Average of normal monthly precipitation recorded at Chadds Ford, Marcus Hook, and Philadelphia Airport for 1951–80.

Monthly precipitation totals at Chadds Ford, Marcus Hook, and the Philadelphia Airport for 1981–83 are shown in Figure 13, which illustrates both the variability of precipitation at each station within each year and the variability of precipitation between stations.

Evapotranspiration

If enough water is available to supply the needs of plants and to maintain soil moisture at saturation, evaporation from the soil and transpiration by plants proceed at a maximum rate called potential evapotranspiration. The rate of actual evapotranspiration is usually less than the potential rate because potential evapotranspiration usually exceeds the quantity of water available from precipitation. During times of no precipitation, water for evapotranspiration comes from soil moisture. Soil moisture is replenished when precipitation exceeds actual evapotranspiration.

Potential evapotranspiration is related to temperature and was computed using Thornthwaite's equation (Thornthwaite, 1944) and Criddle's adjustment (Criddle, 1958) from temperature data at Marcus Hook for 1981–83. Marcus Hook is the station that most closely approximates the average precipitation and temperature for Delaware County. Mean monthly temperature, precipitation, and potential evapotranspiration are compared in Figure 14. Evapotranspiration varies seasonally. Generally, water surpluses, when precipitation exceeds potential evapotranspiration, occur during the winter months, and water deficits occur during the summer months.

Annual Budget

A water budget is an estimate of water entering and leaving an area, plus or minus changes in storage, during a given period of time. Water enters as precipitation and leaves as streamflow, groundwater underflow, and evapotranspiration, plus or minus changes in groundwater and soil-moisture storage.

A simplified water budget for Delaware County was calculated. If it is assumed that the change in storage is negligible, the water-budget equation is expressed as follows:

$$P = R_d + R_b + ET$$

where

P = precipitation,
R_d = direct runoff,
R_b = baseflow, and
ET = evapotranspiration.

Total runoff was converted to inches of water over the drainage basin. An average percentage of base flow for the county was calculated from proportional baseflow percentages based on the relative sizes of the drainage basins. Total runoff (R_t), in inches of water, can be expressed as follows:

$$R_t = R_d + R_b$$
$$20.43 = 6.73 + 13.70$$

Using the average of the normal precipitation recorded at the three stations and the weighted runoff figures above, the budget equation, in inches of water, can be expressed as follows:

$$P = R_d + R_b + ET$$
$$43.46 = 6.73 + 13.70 + 23.03$$

Because the total water in storage in Delaware County was estimated to be 30 inches, average annual baseflow is equal to about 46 percent of the total volume of water in storage in the county.

GROUNDWATER RESOURCES

QUANTITY

Influence of Topography

Topography is an important factor to consider when drilling a well. Table 11 summarizes well yields, depths to water, and depths of well casings by topographic position. These factors were considered independent of the formation in which the wells are located. Wells drilled in valleys tend to have a higher yield and shallower depth to water than wells located on higher ground. The median depth of casing for all wells, regardless of topographic position, is about 40 feet below land surface.

The median yield of wells in valleys is 30 gal/min, compared with medians of 10 gal/min for both hillsides and hilltops. The range of yields of wells in valleys also is greater than the range of yields of wells in higher topographic positions. These statistics indicate both a greater chance of securing adequate water supplies and more variability in the yields of wells in valleys.

The median depth to water for wells in valleys is 11.1 feet below land surface but is 27.0 feet for hillsides and 34.5 feet for hilltops. Depth to water is least variable and shallowest for wells in valleys.

Depths of Wells

The depths of drilled wells in the major water-bearing rock units are summarized in Table 12. The Wissahickon Formation has the widest range and the greatest median well depth. Median well depths are

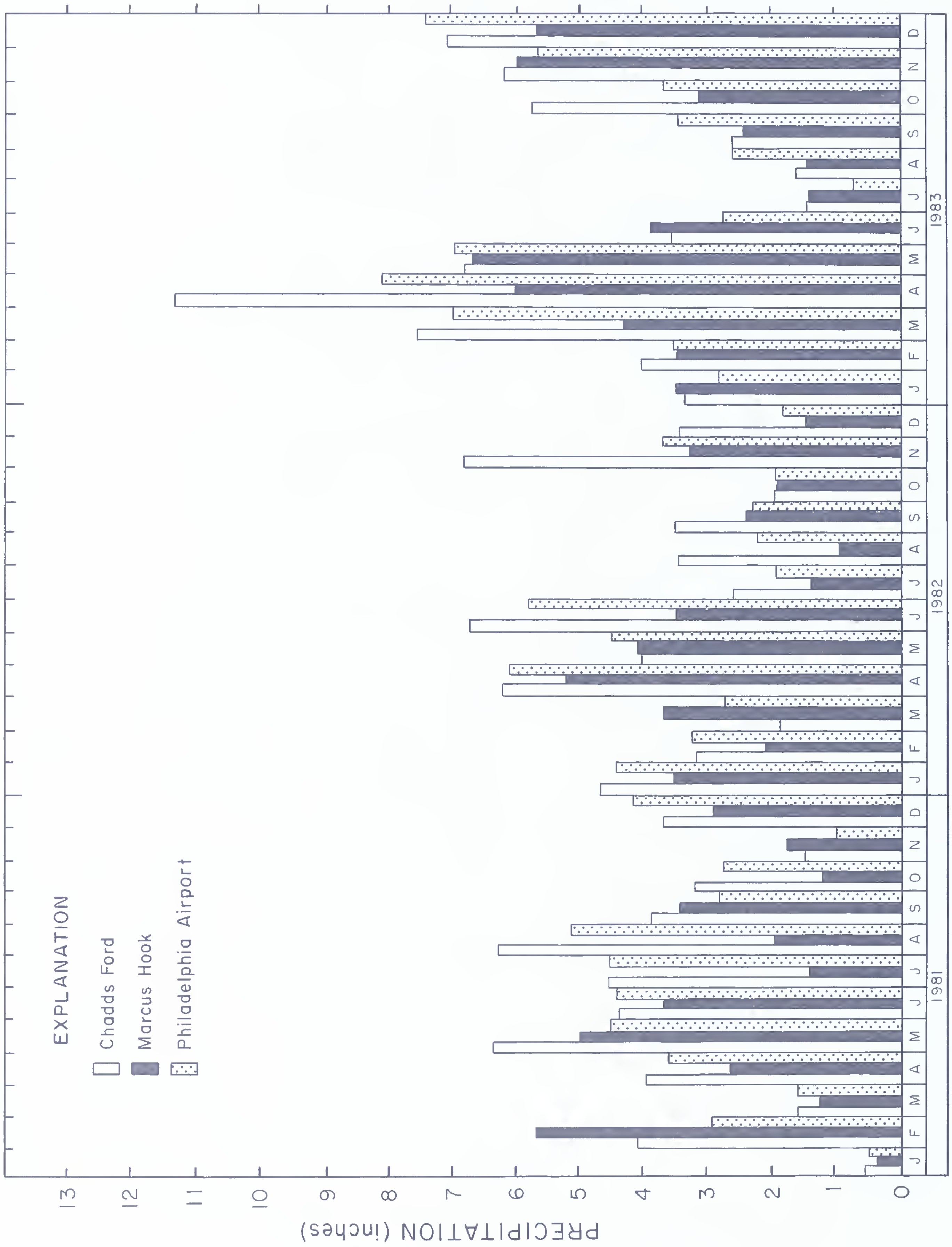


Figure 13. Monthly precipitation at Chadds Ford, Marcus Hook, and Philadelphia Airport for 1981–83.

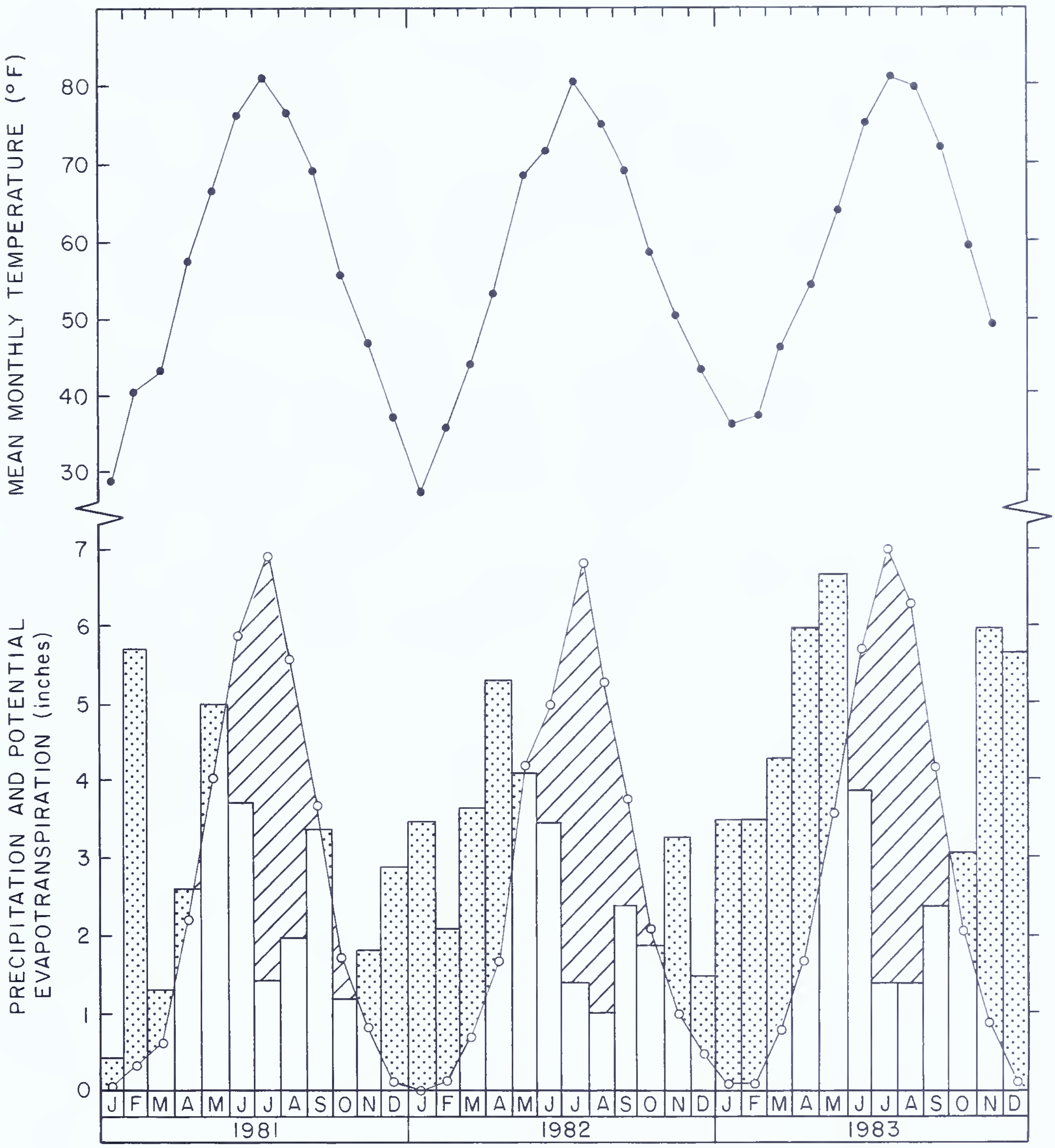


Figure 14. Mean monthly temperature, precipitation, and potential evapotranspiration at Marcus Hook, 1981–83. Dotted pattern, water surplus; diagonal pattern, water deficit.

comparable in the granodioritic and felsic gneiss, mafic gneiss, and ultramafite. The median depth for wells in anorthositic gneiss was not determined because of the small number of wells reported but is probably similar to that of the above rock types. The shallowest well depth in ultramafite is 80 feet, which is much deeper than the shallowest wells in the other rock units.

Figure 15 shows the cumulative frequency distributions of depths of drilled wells in the mafic gneiss, granodioritic and felsic gneiss, and Wissahickon Formation. Deep wells are most prevalent in the Wissahickon Formation.

Depths of Well Casings

The depths of well casings for the major water-bearing rock units are summarized in Table 13. Depth of well casing can be used to estimate the thickness of the weathered zone above solid bedrock, although

Table 11. *Relations of Well Yields, Depths to Water, and Depths of Well Casings to Topographic Position*

Topographic position	Well yield (gal/min)			Depth to water (feet)			Depth of well casing (feet)		
	Number of wells	Range	Median	Number of wells	Range	Median	Number of wells	Range	Median
Hilltop	43	0.50–65	10	39	5.87–250	34.5	38	12–85	38
Hillside	181	0–150	10	178	.74–179	27.0	172	14–486	40
Valley	62	3.0–300	30	52	.06–60.0	11.1	49	4–108	40

it is not a precise indicator because casing is commonly driven to a depth below the weathered zone.

The Wissahickon Formation, granodioritic and felsic gneiss, and mafic gneiss all have a median depth of casing of about 40 feet. The range of six casing depths for anorthositic gneiss is from 20 to 31 feet. These limited data suggest that the anorthositic gneiss is more resistant to weathering. The ultramafite has a median depth of casing of 62 feet. Thus, ultramafite is less resistant to weathering than the other consolidated rocks.

Depths to Water

The depths to water for the major water-bearing rock units are summarized in Table 14. Depth to water is more dependent on well location than it is on rock type (see the section "Influence of Topography"). The median depth to water is highest for the granodioritic and felsic gneiss.

Yields

Yield is usually considered to be the most important characteristic of a water-bearing rock unit.

Table 12. *Depths of Drilled Wells in the Major Water-Bearing Rock Units*

Geologic unit	Number of wells	Depth of wells (feet)	
		Range	Median
Trenton gravel	14	10–51	28
Anorthositic gneiss	6	49–360	—[1]
Granodioritic and felsic gneiss	147	43–500	142
Mafic gneiss	58	38–361	146
Ultramafite	9	80–340	117
Wissahickon Formation	132	43–675	187

[1]Dash indicates insufficient data.

The yields of wells for the major water-bearing rock units are summarized in Table 15. These figures were obtained without separation of wells by use. Sixty-six percent of the wells for which the use was reported are domestic wells, 20 percent are unused, and the remainder are distributed among other uses.

Wells in the Trenton gravel have the highest median yield at 50 gal/min; however, the limited thickness of these deposits limits the sustained withdrawal of large amounts of water. Wells in the Wissahickon Formation have the highest median yield for the crystalline water-bearing rock units at 20 gal/min. All of the crystalline water-bearing rock units have wells that yield less than 2 gal/min, which is considered the minimum necessary for a domestic supply. Wells in ultramafite have a median yield of 18 gal/min, or slightly less than that of the Wissahickon Formation, making ultramafite a fairly reliable water source. The maximum yield of nine wells in ultramafite was only 60 gal/min. Wells in the granodioritic and felsic gneiss and in the mafic gneiss have median yields of 6 gal/min and maximum yields of 100 and 150 gal/min, respectively.

Figure 16 shows the cumulative frequency distribution of the yields of wells in the mafic gneiss, granodioritic and felsic gneiss, and the Wissahickon Formation. Wells in the Wissahickon Formation have higher yields than those in the other rock units. About 10 percent of wells in this formation can be expected to yield 65 gal/min or more. Wells in the mafic gneiss yield less than wells in the other rock units. More than 20 percent of the wells in the mafic gneiss have yields of less than 2 gal/min.

Because well drilling is generally discontinued when a sufficient amount of water is encountered, yield cannot be directly correlated with depth. Table 16 gives the number of water-bearing zones per 100 feet of uncased borehole in specified depth intervals for each rock unit. Where the footage drilled per interval is large enough for comparison (greater than 400 feet) all of the units show a decreasing number of water-bearing zones penetrated with increasing depth.

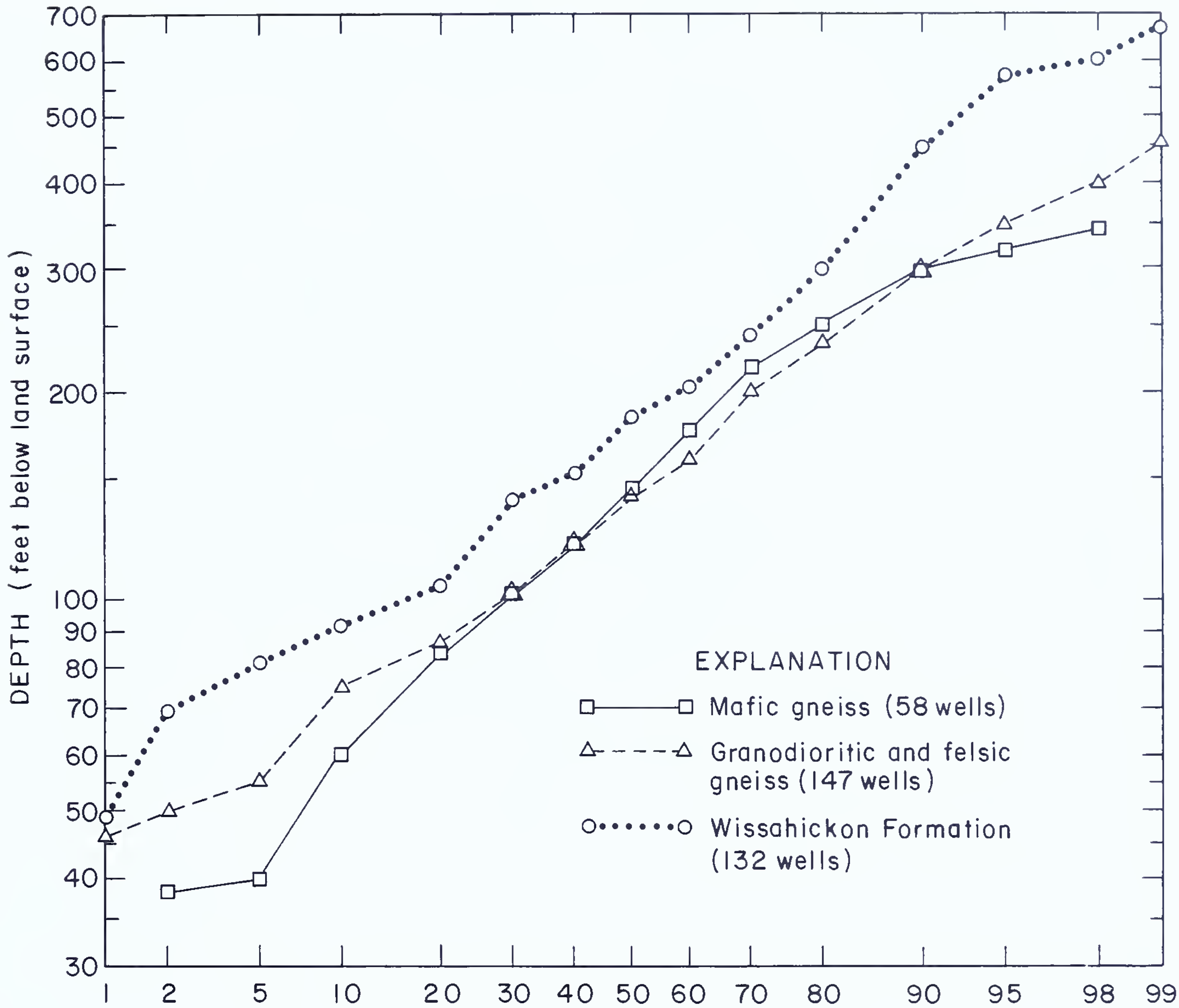


Figure 15. Cumulative frequency distributions of the depths of drilled wells in the mafic gneiss, granodioritic and felsic gneiss, and Wissahickon Formation.

Table 13. *Depths of Well Casings for Wells in the Major Water-Bearing Rock Units*

Geologic unit	Number of wells	Depth of well casing (feet)	
		Range	Median
Trenton gravel	4	16–20	—[1]
Anorthositic gneiss	6	20–31	—
Granodioritic and felsic gneiss	129	6–108	40
Mafic gneiss	54	16–105	40
Ultramafite	8	43–90	62
Wissahickon Formation	114	4–127	40

[1]Dashes indicate insufficient data.

Table 14. *Depths to Water for Wells in the Major Water-Bearing Rock Units*

Geologic unit	Number of wells	Depth to water (feet)	
		Range	Median
Trenton gravel	6	1–15	—[1]
Anorthositic gneiss	6	7.1–35	—
Granodioritic and felsic gneiss	134	1–250	29
Mafic gneiss	53	2–180	25
Ultramafite	8	5.0–40	20
Wissahickon Formation	112	1.0–85	20

[1]Dashes indicate insufficient data.

Table 15. *Yields of Wells in the Major Water-Bearing Rock Units*

Geologic unit	Number of wells	Yield (gal/min)	
		Range	Median
Trenton gravel	9	8.0–200	50
Anorthositic gneiss	6	1.0–35	—[1]
Granodioritic and felsic gneiss	136	0–100	10
Mafic gneiss	55	.5–150	6
Ultramafite	9	2.0–60	18
Wissahickon Formation	127	1.0–300	20

[1]Dash indicates insufficient data.

Much of the water yielded by wells in the crystalline rocks is encountered within 300 feet of the land surface.

Specific Capacities

Specific capacity is the ability of a well to produce a certain yield per foot of drawdown. Specific capacity is partially dependent on the degree of development of a well. Proper development can increase yield and specific capacity, providing a more consistent sustained yield over time.

Specific capacities for wells in the major water-bearing rock units are summarized in Table 17. Wells in the Trenton gravel deposits have the highest specific capacities because the Trenton gravel deposits have a much higher transmissivity than the crystalline rocks.

Wells in the Wissahickon Formation, granodioritic and felsic gneiss, and ultramafite all have a median specific capacity of about 0.2 (gal/min)/ft (gallons per minute per foot of drawdown). Wells in mafic gneiss have a median specific capacity of 0.08 (gal/min)/ft.

The frequency distributions of the specific capacities of wells in the mafic gneiss, granodioritic and felsic gneiss, and the Wissahickon Formation are shown in Figure 17. The specific capacities of wells in the mafic gneiss are consistently lower than those of wells in the other units.

QUALITY

All data on groundwater quality that are available for Delaware County are presented in Tables 36 through 40. For wells for which two or more samples were collected, other tables in this report that include water-quality data show only the most recent sample for data analysis. Table 18 gives the USEPA drinking-water-quality criteria for selected constituents.

Field Determinations

Field determinations of hardness, pH, and specific conductance are summarized in Table 19. Hardness refers to the content of metallic ions, primarily Ca^{2+} and Mg^{2+}, that react with sodium soaps to produce solids or scummy residue, and that react with anions when the water is evaporated in boilers to produce solid boiler scale (Camp, 1963). The calcium and magnesium ions associated with hardness also can cause corrosion. Water that has sufficient hardness to reduce the effectiveness of soap or cause boiler scale is undesirable. Determinations of the degree of hardness are based on the following generally accepted rating scale:

Hardness range (mg/L of $CaCO_3$)	*Description*
0–60	Soft
61–120	Moderately hard
121–180	Hard
More than 180	Very hard

Most of the water in Delaware County can be classified as soft to moderately hard, except for some water in the granodioritic and felsic gneiss that can be classified as hard and very hard. Hardness of water in the county ranges from 17 to 3,300 mg/L. The median hardness is similar for most crystalline-rock water-bearing units. One water sample from the Trenton gravel was determined in the laboratory to have a hardness of 140 mg/L. Although sample sizes for the Trenton gravel, ultramafite, and anorthositic gneiss were too small to derive medians, the ranges are comparable to those for the other units.

The pH of water is a measure of hydrogen-ion activity. Values greater than 7 indicate alkaline water, and values less than 7 indicate acidic water; a value of 7 is neutral. Acidic water tends to be corrosive and can dissolve trace metals more readily than can alkaline water. The pH of water for industrial purposes can be chemically altered to fit the needs of various processes. Water for domestic purposes can be treated adequately with water softening or neutralizing equipment.

Values of pH vary slightly in each rock unit. Water from the Wissahickon Formation has a pH range from 5.4 to 8.0 and a median pH of 6.4. Water from the mafic gneiss has the same median. Water from the granodioritic and felsic gneiss has the high-

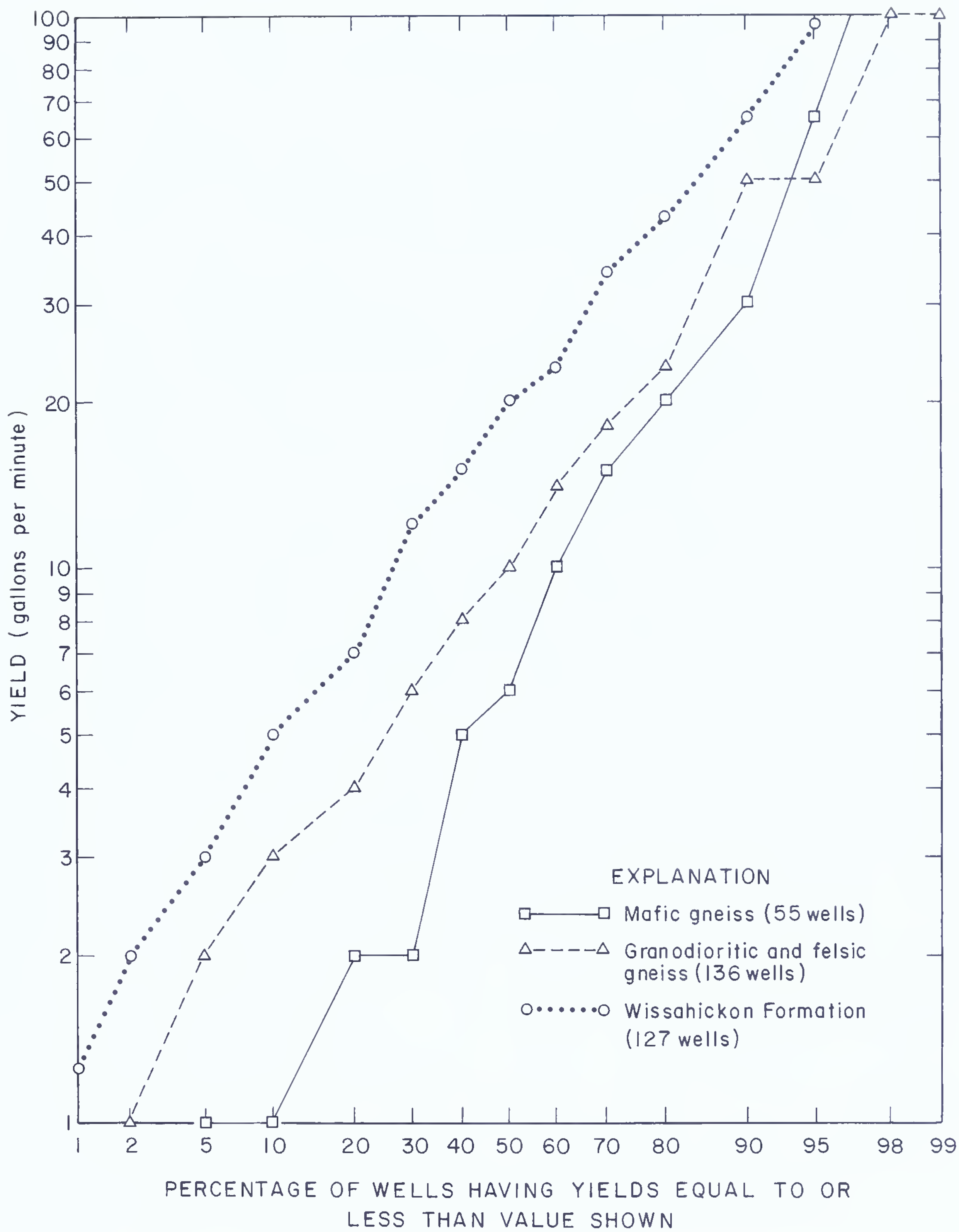


Figure 16. Cumulative frequency distributions of the reported yields of wells in the mafic gneiss, granodioritic and felsic gneiss, and Wissahickon Formation.

est median at 6.5. Four of five water samples from ultramafite are alkaline; however, this number of samples is insufficient to derive a median. One sample from the Trenton gravel tested in the laboratory has a pH of 7.6. The lowest measured pH is 5.2 from the mafic gneiss. Many of the samples tested were below the USEPA recommended range of 6.5 to 8.5. Treatment is less expensive within this range, and the pH is easily adjusted.

Specific conductance is a measure of the ability of water to conduct an electrical current and depends on the amount and nature of the dissolved constituents

Table 16. *Number of Water-Bearing Zones Reported Per 100 Feet of Uncased Borehole Drilled for the Major Crystalline Rock Units*

	Anorthositic gneiss (5 wells)			Granodioritic and felsic gneiss (118 wells)			Mafic gneiss (53 wells)			Ultramafite (8 wells)			Wissahickon Formation (88 wells)			All geologic units (272 wells)		
	Number of water-bearing zones			Number of water-bearing zones			Number of water-bearing zones			Number of water-bearing zones			Number of water-bearing zones			Number of water-bearing zones		
Interval (feet)	Pene-trated	Per 100 feet of borehole	Footage drilled (feet)	Pene-trated	Per 100 feet of borehole	Footage drilled (feet)	Pene-trated	Per 100 feet of borehole	Footage drilled (feet)	Pene-trated	Per 100 feet of borehole	Footage drilled (feet)	Pene-trated	Per 100 feet of borehole	Footage drilled (feet)	Pene-trated	Per 100 feet of borehole	Footage drilled (feet)
0–50	2	1.7	117	42	3.5	1,210	20	4.0	494	1	14.0	7	28	3.3	859	93	3.5	2,687
51–100	3	1.3	228	125	2.7	4,643	43	2.2	1,921	8	3.7	217	84	2.2	3,734	263	2.4	10,743
101–150	0	0	200	56	1.7	3,326	23	1.5	1,554	3	1.3	227	53	1.7	3,138	135	1.6	8,445
151–200	3	1.7	180	26	1.3	1,966	10	1.0	1,016	2	1.0	200	26	1.3	2,063	67	1.2	5,425
201–250	2	2.0	100	15	1.4	1,050	9	1.2	754	1	.9	114	9	.8	1,079	36	1.2	3,097
251–300	0	0	80	3	.5	600	5	1.1	438	0	0	50	6	.8	793	14	.7	1,961
Greater than 300	1	1.7	60	1	.2	453	3	2.8	107	2	5.0	40	9	.7	1,279	16	.8	1,939
Total (mean)	11	(1.1)	965	268	(2.0)	13,248	113	(1.8)	6,284	17	(2.0)	855	215	(1.7)	12,945	624	(1.8)	34,297

Table 17. *Specific Capacities of Wells in the Major Water-Bearing Rock Units*

Geologic unit	Number of wells	Specific capacity [(gal/min)/ft] Range	Median
Trenton gravel	3	1.3–2.6	—[1]
Anorthositic gneiss	5	.01–.50	—
Granodioritic and felsic gneiss	106	.002–14	0.16
Mafic gneiss	44	.002–6.0	.08
Ultramafite	8	.01–.6	.22
Wissahickon Formation	72	.004–2.9	.20

[1]Dashes indicate insufficient data.

in the water. Specific conductance of water from wells in the major water-bearing rock units ranges from 55 μmho/cm (micromhos per centimeter at 25°C), recorded for water from the Wissahickon Formation, to 3,900 μmho/cm for one sample of water from the granodioritic and felsic gneiss. The high value of specific conductance of this sample is caused by groundwater contamination. The Wissahickon Formation, granodioritic and felsic gneiss, and mafic gneiss all have similar median specific conductances. Those rock units in which the number of samples are too small to derive medians show similar ranges and values.

Inorganic Constituents

The most recent laboratory analytical results for 42 wells for inorganic constituents are given in Table 20. Groundwater in Delaware County is generally of good quality, suitable for human consumption and most other uses. Nitrate concentrations for 37 water samples range from 0.07 to 7.2 mg/L, and the median is 2.6 mg/L (the USEPA maximum contaminant level [MCL] is 10 mg/L). Concentrations above this limit can be harmful to infants and possibly to adults if continually ingested. Sources of nitrates include fertilizers, decaying vegetation, animal wastes, and sewage.

Calcium concentrations in 38 water samples range from 4.2 to 140 mg/L; the median is 22 mg/L. The ultramafite, anorthositic gneiss, and mafic gneiss generally have the lowest concentrations of calcium. The granodioritic and felsic gneiss and the Wissahickon Formation have the widest ranges of calcium concentration, 11 to 140 mg/L and 12 to 130 mg/L, respectively. The median calcium concentration for the Wissahickon Formation is 32 mg/L.

Magnesium concentrations for 38 water samples range from 2.4 to 62 mg/L, and the median is 8.7 mg/L. Generally, water from ultramafite has the highest magnesium concentrations. The median concentrations in water from the other units are near 8.5 mg/L. Elevated concentrations of magnesium can corrode pipes and plumbing fixtures.

Sodium concentrations in 37 water samples range from 2.3 to 98 mg/L; the median is 9.3 mg/L. Water from the Wissahickon Formation has the highest median sodium concentration, 21 mg/L. Water from the other rock units generally has sodium concentrations of less than 15 mg/L.

Potassium concentrations were determined for 37 water samples; they range from 0.30 to 17 mg/L, and the median is 2.4 mg/L.

Chloride concentrations in 42 water samples range from below the detection limit to 1,800 mg/L, and the median is 23 mg/L. The USEPA MCL is 250 mg/L. Concentrations above this limit cause a noticeable salty taste, and elevated concentrations of chloride can corrode pipes and plumbing fixtures. Chlorides are not removed in conventional water treatment. Possible sources of high chloride concentrations are storage and runoff of highway deicing salts. The Wissahickon Formation has the highest concentrations of chloride, although the median is only 38 mg/L.

Concentrations of sulfate in 38 water samples range from 1.0 to 94 mg/L, and the median is 31 mg/L. These are all below the USEPA MCL of 500 mg/L. The highest concentration of sulfate, 94 mg/L, is in a sample from the Wissahickon Formation.

Total dissolved solids should not exceed the USEPA secondary maximum contaminant level (SMCL) of 500 mg/L because of adverse physiological effects, mineral taste, or corrosion of plumbing fixtures. Water in Delaware County generally is low in dissolved solids, ranging from 69 to a high of 1,600 mg/L, and having a median of 187 mg/L. Only two samples exceed a concentration of 400 mg/L. The USEPA has set no mandatory limit on total dissolved solids because standards have been set on the two most troublesome salts that contribute to its content, chlorides and sulfates.

Concentrations of iron for 38 water samples range from less than 3 to 120,000 μg/L, and the median is 25 μg/L. The USEPA SMCL is 300 μg/L. The Wissahickon Formation has the highest median iron concentration, 180 μg/L; 6 out of 14 samples exceed the USEPA SMCL. All of the other rock units from which more than one sample was analyzed also have concentrations above the SMCL. Because it is easily precipitated, iron above this limit can stain ceramics, laundry, and pipes, and can also impart a disagreeable taste to drinking water.

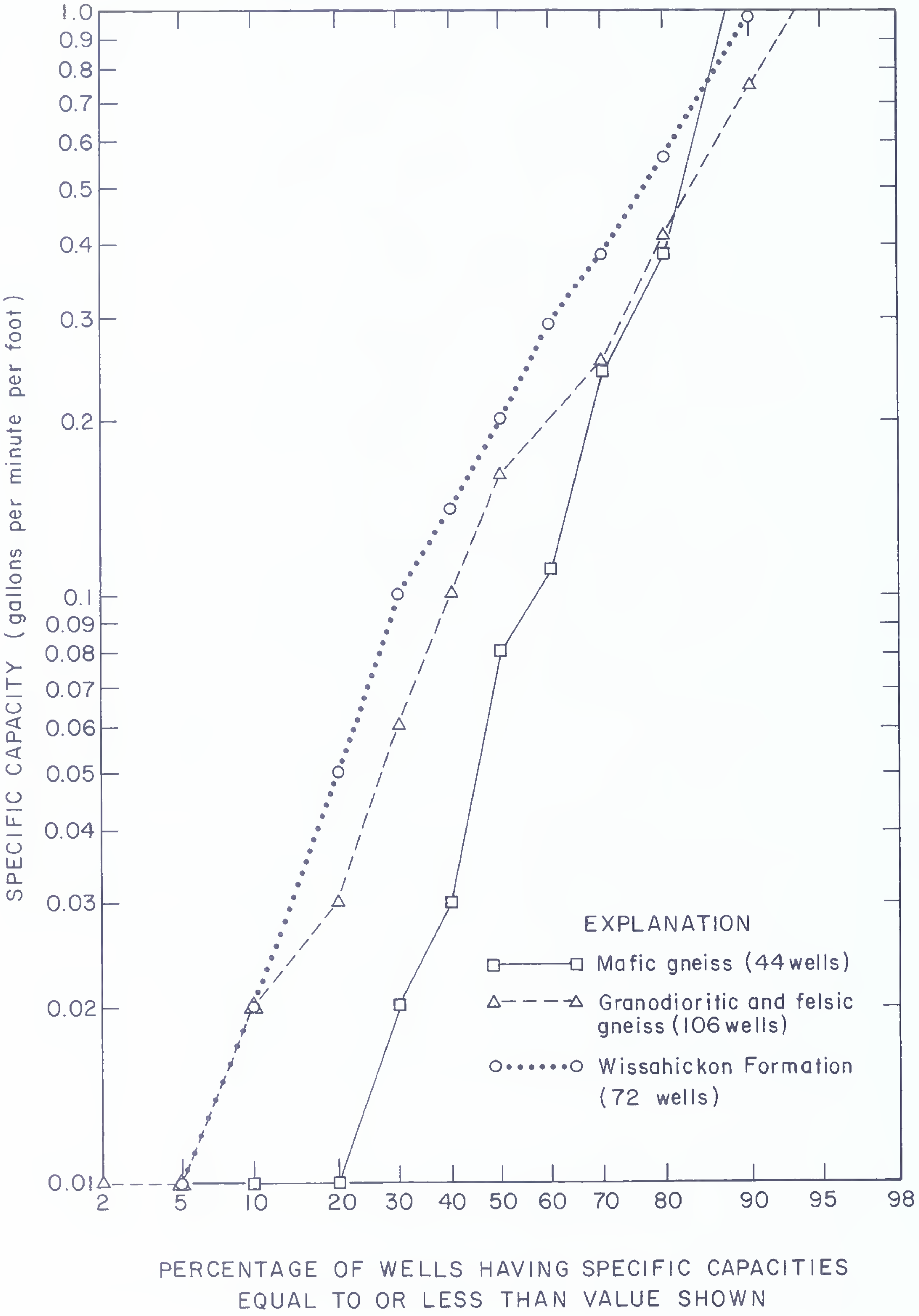


Figure 17. Cumulative frequency distributions of the specific capacities of wells in the mafic gneiss, granodioritic and felsic gneiss, and Wissahickon Formation.

Table 18. *Maximum Concentrations for Selected Dissolved Constituents Established for Drinking Water*

(From U.S. Environmental Protection Agency, 1996)

Constituent	Criterion
Chloride	250 mg/L
Iron	300 μg/L
Lead	15 μg/L
Manganese	50 μg/L
Nitrate, dissolved as nitrogen	10 mg/L
pH (range)	6.5–8.5 units
Sulfate	500 mg/L

Concentrations of lead in 31 water samples range from less than 1 to 14 μg/L; the median is 5 μg/L. The USEPA action level is 15 μg/L. Lead is toxic and tends to accumulate in the tissues of humans and other mammals. Lead amounts in all samples tested are below the action level.

Concentrations of manganese in 33 samples range from less than 1 to 13,000 μg/L, and the median is 11 μg/L. The USEPA SMCL is 50 μg/L. Water in all rock units contains acceptable levels of manganese except the Wissahickon Formation, in which 9 of 13 samples have concentrations above the USEPA limit. Manganese, which is commonly associated with iron, can cause a bitter taste as well as contribute to staining of laundry and fixtures.

Concentrations of nickel in 31 samples range from less than 1 to 13 μg/L, and have a median of 2 μg/L.

Phenols and Organic Compounds

Approximately 17 water samples were analyzed for phenols and volatile organic compounds. Table 21 lists those analyses in which detectable concentrations of phenols or volatile organic compounds were observed. The USEPA has established a health advisory for children of 6 μg/L for phenols (total) in water. Water samples from wells De-844 and De-867 contain 2 μg/L. Phenolic compounds are used in industrial and medical applications as chemical reagents and disinfectants. They are toxic to humans through ingestion or skin absorption (Windholz and others, 1976, p. 941). All of these detected substances are synthetic and represent the contamination of groundwater by man's activities. Although statistical conclusions cannot be drawn from this sample size, groundwater contamination by organic compounds has occurred in Delaware County.

Site-Specific Contamination

Improper storage and disposal of chemicals have resulted in contamination of groundwater in Delaware County. In their study for the USEPA, Pease and Lewis (1982) described a property that was formerly the site of a company that stripped and recycled tires and other rubber products. The site is in the city of Chester and is along the Delaware River adjacent to the Commodore Barry Bridge. It became the eventual dump site for approximately 2,500 drums and five large tanker containers of toxic chemicals, mainly cyanides, flammable organic compounds, organic and nonorganic aqueous solutions, solids, and sludges.

The site is underlain by the Trenton gravel, which is between 15 and 25 feet thick locally and overlies the Wissahickon Formation. Pease and Lewis (1982) determined that the site is in an area of groundwater discharge to the Delaware River; the hydraulic gradient is low, and some local recharge occurs. A major fire, acid gas fumes, and contamination of air, soil, and groundwater have resulted from the improper storage and disposal of the chemicals. According to the study, soil and groundwater contaminants consist of numerous organic and metal compounds. Some of the latter were determined to have migrated from offsite locations, indicating that this may not be the only contaminated site in the area. The flow of contaminated groundwater to the Delaware River was estimated to be 2,000 gal/day, which, although important, is insignificant compared to the flow of the river. No regional hydrogeologic connections are known to exist.

In a study for the USEPA, Dennis (1984) stated that, from 1947 to 1963, a 2-acre property in Haverford Township was used as the site of a wood-preserving facility. Pentachlorophenol (PCP), dissolved in an oil base, was used for the wood-preserving processes. A shallow injection well was used to dispose of the oil and PCP mixture. Also, significant quantities of preservative probably entered the soil and groundwater from routine handling and spills.

Naylors Run, a tributary to Cobbs Creek, is located in the vicinity of the wood-preserving facility. The area is underlain by the Wissahickon Formation. Oil and PCP contamination of the groundwater occurred over 4.5 acres. The contamination reached Naylors Run through infiltration and flow in a storm sewer discharging to the stream. Aquatic life was absent within 1 mile downstream of the site, and was stressed farther downstream where the contaminants were diluted and somewhat dispersed. Initial treatment consisted of pumping and treating contaminated groundwater from three recovery wells. Although

Table 19. *Hardness, pH, and Specific Conductance of Water From Wells in the Major Water-Bearing Rock Units*

Geologic unit	Hardness (mg/L as calcium carbonate)			pH (standard units)			Specific conductance (µmho/cm)		
	Number of wells	Range	Median	Number of wells	Range	Median	Number of wells	Range	Median
Trenton gravel[1]	1	140	—[2]	1	7.6	—	1	362	—
Anorthositic gneiss	3	68–170	—	3	6.3–7.6	—	3	160–450	—
Granodioritic and felsic gneiss	66	32–3,300	86	67	5.4–7.9	6.5	68	60–3,900	210
Mafic gneiss	30	17–240	77	29	5.2–7.4	6.4	30	60–600	185
Ultramafite	5	68–190	—	5	6.1–7.6	—	5	150–360	—
Wissahickon Formation	62	17–220	68	58	5.4–8.0	6.4	64	55–2,200	220

[1]Analyses were performed in the laboratory.
[2]Dashes indicate insufficient data.

Table 20. *Laboratory Analyses of Inorganic Constituents From Wells in the Major Water-Bearing Rock Units*

Well number	Geologic unit	Nitrogen, nitrate, dissolved (mg/L as N)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)	Solids, residue at 180°C, dissolved	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)	Manganese, dissolved (µg/L as Mn)	Nickel, dissolved (µg/L as Ni)
De– 28	Trenton gravel	4.7	33	15	—[1]	—	BD[2]	79	251	340	—	BD	—
200	Anorthositic gneiss	5.9	14	7.4	8.6	1.5	12	4.6	140	210	—	—	—
50	Felsic gneiss	2.6	29	12	9.0	17	8.1	46	206	6	13	<1	2
82	do.	<.10	19	4.6	4.5	3.3	25	31	131	3,000	2	75	5
95	do.	5.4	24	11	13	1.6	10	33	187	7	9	2	2
116	do.	3.9	23	9.0	15	1.4	21	34	191	6	4	<1	3
381	do.	2.5	11	4.2	5.8	1.4	5.2	4.3	85	4,100	—	—	—
454	do.	.36	33	13	9.3	3.5	27	40	239	<3	5	4	3
455	do.	1.5	19	9.5	6.2	2.4	10	44	204	85	2	4	7
678	do.	1.8	140	41	11	6.5	510	31	929	25	6	<1	5
680	do.	2.4	31	8.2	9.1	2.3	29	18	204	<3	8	<1	2
723	do.	6.3	25	9.2	9.5	1.6	15	38	190	12	6	8	5
748	do.	4.1	12	6.0	5.2	1.3	7.2	17	120	7	3	4	3
772	do.	3.6	13	3.3	4.7	2.1	8.0	5.1	90	18	4	4	1
815	do.	—	13	6.7	6.9	2.8	25	11	109	8	5	16	1
839	do.	—	—	—	—	—	19	—	—	—	—	—	—
840	do.	—	—	—	—	—	43	—	—	—	—	—	—
841	do.	—	—	—	—	—	1,800	—	—	—	—	—	—
842	do.	—	—	—	—	—	20	—	—	—	—	—	—
33	Mafic gneiss	3.4	19	8.7	7.0	1.6	13	26	150	22	14	1	3
393	do.	3.6	18	11	37	1.9	82	24	69	61	5	11	2
402	do.	.07	14	6.7	6.4	2.2	9.6	40	126	4,000	—	—	—
558	do.	3.6	36	12	37	2.8	100	17	346	12	12	19	1
802	do.	1.1	12	6.2	8.6	1.5	12	7.9	115	800	4	16	2
844	do.	2.1	8.0	6.0	11	.8	36	1.0	133	110	8	95	<1
136	Ultramafite	7.2	4.2	18	2.6	.8	11	3.2	111	5,400	—	—	—
694	do.	1.4	8.2	2.4	3.7	1.8	9.0	26	182	5	7	2	2
720	do.	4.9	8.9	16	2.3	.3	8.1	3.6	116	4	2	<1	2
30	Wissahickon	.97	28	10	4.8	1.0	6.3	12	150	60	—	<1	—
356	do.	.10	12	5.1	6.5	1.7	4.8	13	80	870	—	—	—
466	do.	<.10	22	8.8	33	4.0	52	54	244	720	3	98	5
501	do.	6.7	28	16	13	8.7	47	72	280	15	4	170	5
763	do.	3.5	42	12	27	4.3	81	36	369	250	6	160	1
803	do.	2.7	14	6.3	28	2.8	45	35	165	13	11	96	4
830	do.	<.10	130	62	98	12	650	61	1,600	120,000	6	13,000	13
834	do.	2.7	37	16	23	5.5	43	94	322	19,000	8	870	3
836	do.	1.2	39	8.5	46	4.0	50	53	309	680	3	120	1
867	do.	2.9	25	11	14	4.7	38	40	197	6	<1	2	1
869	do.	<.10	12	5.6	8.2	3.5	6.1	30	114	25	2	47	1
874	do.	.11	37	4.5	19	3.3	25	44	204	100	3	100	7
881	do.	3.9	37	8.5	15	2.6	33	48	248	19	2	2	1
882	do.	<.10	37	5.0	23	3.6	27	31	215	1,100	2	530	1

[1]Dashes indicate no data.
[2]BD, below detection limits.

Table 21. *Wells Containing Detectable Concentrations of Phenols and Volatile Organic Compounds*

Well number	Compound	Concentration (µg/L)
De–454	Toluene	2.0
466	Trichloroethylene	5.0
815	Methylene chloride	5.9
830	1,2 Transchloroethylene	11
834	Methylene chloride	5.7
	Tetrachloroethylene	13
	1,2 Transchloroethylene	5.8
	Trichloroethylene	4.2
844	1,2 Dichloroethane	18
	Phenols (total)	2
867	Phenols (total)	2
882	Toluene	3.3

some oil and PCP were recovered, a large quantity of oil- and PCP-contaminated groundwater remains in the vicinity of the site. Oil and PCP continues to discharge, but most of it is collected before it enters Naylors Run.

MAJOR WATER-BEARING FORMATIONS

Undifferentiated Unconsolidated Deposits

Description

Unconsolidated deposits overlie approximately 20 percent of the county. They are present mostly in the eastern part bordering the Delaware River. The high-elevation terrace deposits of the Bridgeton Formation (represented on Plate 1 as Tb) and the Bryn Mawr Formation (Tbm) are unimportant as water-bearing formations, except that they provide additional recharge and storage for the crystalline rocks beneath them. The remainder of the unconsolidated deposits consists of the informally named Trenton gravel (Qt). In this report, unless otherwise specified, data for wells in unconsolidated deposits refer exclusively to the Trenton gravel.

The Trenton gravel is discontinuous in extent and variable in depth. It consists of gravelly sand interstratified with semiconsolidated sand (limonite-cemented) and clay-silt beds. The sediments are poorly sorted, and the wide range in grain size causes the hydrologic properties to vary considerably. The Trenton gravel is commonly gray or pale reddish brown in color. It is present in the lowlands along the Delaware River at elevations of 50 feet or less. It ranges up to 50 feet in thickness but generally is less than 20 feet thick.

The Trenton gravel generally overlies the Wissahickon Formation, except in the extreme northeast corner of the Delaware County part of the Atlantic Coastal Plain, where it overlies the Cretaceous Potomac-Raritan-Magothy aquifer system. In this small area, the Trenton gravel and the Cretaceous sediments probably act as a single aquifer. Otherwise, throughout the county, the Trenton gravel is too discontinuous to act as a single regional aquifer.

Water-Bearing Characteristics

The Trenton gravel is rarely tapped by wells in Delaware County. Nevertheless, it does yield moderate to large supplies of water to wells in some areas, especially where the wells are located near sources of recharge such as undeveloped flat-lying areas. In many areas, the deposits probably are too thin to yield much water to wells over a sustained period, but they do provide temporary storage of water that recharges the underlying units.

Reported data for wells in the Trenton gravel are summarized in Table 22. The depths of wells in the Trenton gravel range from 10 to 51 feet below land surface; the median is 28 feet. Although the statistical sample size is small, the average thickness of the Trenton gravel is probably about 20 feet.

The depths to water in wells in the Trenton gravel range from 0.1 to 15 feet below land surface. This shallow depth to water is related to the proximity of the Trenton gravel to the Delaware River.

The yields of wells in the Trenton gravel range from 8.0 to 200 gal/min; the median is 50 gal/min. Although this is the highest median yield of any of the water-bearing rock units in the county, the gravel should not be considered a major water source because it is generally too thin and discontinuous in most areas. Specific capacities for 3 wells range from 1.3 to 2.6 (gal/min)/ft.

Table 22. *Summary of Hydrologic Characteristics for Wells in the Trenton Gravel*

Hydrologic characteristic	Number of wells	Range	Median
Depth of well (feet)	14	10–51	28
Depth to water (feet)	7	.1–15	—[1]
Yield (gal/min)	9	8.0–200	50
Specific capacity [(gal/min)/ft]	3	1.3–2.6	—

[1]Dashes indicate insufficient data.

Quality of Water

One water sample from well De–28 in the Trenton gravel was analyzed in the laboratory. The results of this analysis are reported in Tables 19 and 20. General conclusions cannot be drawn from one sample. The hardness of the sample is 140 mg/L; the pH, 7.6; and the specific conductance, 362 μmho/cm. The nitrate concentration is 4.7 mg/L; the calcium concentration, 33 mg/L; and the magnesium concentration, 15 mg/L. Of the common salts, the chloride concentration is below the detection limit, and the sulfate concentration is 79 mg/L. Iron was found at a concentration of 340 μg/L, and manganese concentration is below the detection limit. None of these constituents exceed the USEPA criteria for drinking water.

Anorthositic Gneiss

Description

Anorthositic gneiss (represented as wan on Plate 1) is a hard, medium- to coarse-grained crystalline rock that commonly forms hills and ridges. Anorthositic gneiss is present as metamorphosed intrusive bodies and is thought to be of early Paleozoic or Proterozoic Z age. The chief minerals are the feldspars calcic plagioclase and labradorite. It is typically light to dark bluish gray and has spheroidal weathering at the surface. Fresh exposures are pinkish gray and lack the secondary development of zoisite, which replaces the feldspars. Anorthositic gneiss is present in the extreme southern tip of Delaware County. Approximately 2 percent of the county is underlain by anorthositic gneiss.

Water-Bearing Characteristics

Hydrologic data for anorthositic gneiss are available for only six wells. Water is present in secondary fractures and openings. Hydrologic characteristics of wells in anorthositic gneiss are given in Table 23. The depths of wells range from 49 to 360 feet below land surface; this is comparable to ranges for the other major water-bearing units in the county. Anorthositic gneiss is a very resistant rock; therefore, the depth of the weathered zone generally is less than that of other rock units. The depths of well casings range from 20 to 31 feet below land surface. The depths to water range from 7 to 35 feet below land surface.

The yields of wells completed in anorthositic gneiss range from 1.0 to 35 gal/min, and yields of most wells are insufficient for anything but single-family domestic supplies. Major water-bearing zones appear to be shallow because no wells deeper than 200 feet yield more than 6.0 gal/min. Topographic location may not influence yield in this rock unit to the degree it does in other major water-bearing rock units in Delaware County. The specific capacities of wells in anorthositic gneiss range from 0.01 to 0.50 (gal/min)/ft. This small range is probably the result of the small number of wells studied.

Table 23. *Summary of Hydrologic Characteristics for Wells in Anorthositic Gneiss*

Hydrologic characteristic	Number of wells	Range
Depth of well (feet)	6	49–360
Depth of well casing (feet)	6	20–31
Depth to water (feet)	6	7.1–35
Yield (gal/min)	6	1.0–35
Specific capacity [(gal/min)/ft]	5	.01–.50

Quality of Water

Field determinations for hardness, pH, and specific conductance were made for water from three wells in anorthositic gneiss. The results are given in Table 24. A water sample from well De–200 was tested in the laboratory, and the analytical results are given in Table 20.

Table 24. *Summary of Water-Quality Data for Wells in Anorthositic Gneiss*

(Quantities are in milligrams per liter unless otherwise indicated)

Parameter	Number of samples	Range
Hardness (as calcium carbonate)	3	68–170
pH (units)	3	6.3–7.6
Specific conductance (μmho/cm)	3	160–450
Nitrate (as nitrogen)	1	5.9
Calcium	1	14
Magnesium	1	7.4
Sodium	1	8.6
Potassium	1	1.5
Chloride	1	12
Sulfate	1	4.6
Total dissolved solids	1	140
Iron (μg/L)	1	210

Granodioritic and Felsic Gneiss

Description

The granodioritic and felsic gneiss includes foliated metamorphic rocks containing predominantly

light minerals such as quartz and feldspar. The rocks are generally medium grained, and some of the felsic gneiss units contain pyroxene and/or hornblende. The felsic gneiss (Ybfa and Ybfg on Plate 1) is of Proterozoic Y age, whereas the granodioritic gneiss (gr) is of early Paleozoic or Proterozoic Z age. The water-bearing properties of the felsic gneiss and the granodioritic gneiss are similar, and, in this report, they are considered together. Water is present in secondary openings in the rock. Approximately 28 percent of the county is underlain by granodioritic and felsic gneiss.

Table 25. *Summary of Hydrologic Characteristics for Wells in the Granodioritic and Felsic Gneiss*

Hydrologic characteristic	Number of wells	Range	Median
Depth of well (feet)	147	43–500	142
Depth of well casing (feet)	129	6–108	40
Depth to water (feet)	134	1–250	29
Yield (gal/min)	136	0–100	10
Specific capacity [(gal/min)/ft]	106	.002–14	.16

Water-Bearing Characteristics

The hydrologic characteristics of wells in the granodioritic and felsic gneiss are summarized in Table 25. In Table 26, the cumulative frequency distributions of depths of wells, depths of well casings, depths to water, yields, and specific capacities are listed.

The reported depths of wells in the granodioritic and felsic gneiss range from 43 to 500 feet below land surface; the median is 142 feet. This is the second-widest range of well depths in the county. The median well depth is similar to that of the mafic gneiss. Seventy-five percent of wells completed in granodioritic and felsic gneiss are at least 100 feet deep. Only 25 percent are 220 feet or deeper.

The reported depths of casings of wells in granodioritic and felsic gneiss range from 6 to 108 feet below land surface; the median is 40 feet. These are similar to the depths of casings for mafic gneiss and the Wissahickon Formation. Only 10 percent of wells completed in granodioritic and felsic gneiss have depths of well casings less than 21 feet below land surface; only 25 percent of the wells have well-casing depths of 50 feet or greater.

The reported depths to water in wells in granodioritic and felsic gneiss range from 1 to 250 feet below land surface; the median is 29 feet. This is the highest median for depths to water of all the water-bearing rock units in the county. Ninety percent of the wells in granodioritic and felsic gneiss have depths to water of at least 10 feet. Twenty-five percent of the wells have depths to water of 40 feet or more.

The reported yields of wells in the granodioritic and felsic gneiss range from 0 to 100 gal/min, and the median is 10 gal/min. This median is comparable to that of the mafic gneiss. Most water-bearing zones encountered are less than 250 feet below land surface. High yields should not be expected because the maximum reported yield is only 100 gal/min. Only 25 percent of wells in this formation have yields that equal or exceed 20 gal/min, and 25 percent of the wells have yields of less than 5 gal/min.

Table 26. *Cumulative Frequency Distributions of Reported Well Depths, Depths of Well Casings, Depths to Water, Yields, and Specific Capacities for Wells in the Granodioritic and Felsic Gneiss*

Hydrologic characteristic	Number of wells	90 percent[1]	75 percent[1]	50 percent[1]	25 percent[1]	10 percent[1]
Depth of well (feet)	147	75	100	142	220	300
Depth of well casing (feet)	129	21	28	40	50	62
Depth to water (feet)	134	10	16	29	40	56
Yield (gal/min)	136	3	5	10	20	50
Specific capacity [(gal/min)/ft]	106	.02	.05	.16	.36	.74

[1]Percentage of wells in which indicated value is equaled or exceeded.

The reported specific capacities of wells in the granodioritic and felsic gneiss range from 0.002 to 14 (gal/min)/ft; the median is 0.16 (gal/min)/ft. This is comparable to specific capacities for the other water-bearing units in the county. Only 10 percent of wells in this unit have a specific capacity of 0.74 (gal/min)/ft or more.

The probability of obtaining higher yields is increased by locating wells in valleys or draws. Wells can be expected to yield 10 gal/min and can yield up to 40 gal/min if properly located and developed.

Quality of Water

Water-quality data for wells in the granodioritic and felsic gneiss are summarized in Table 27. The hardness of water samples ranges from 32 to 3,300 mg/L; the median is 86 mg/L. The median is slightly higher than that of the other units. Only three samples have hardnesses greater than 300 mg/L. Most water in the granodioritic and felsic gneiss is soft to moderately hard.

The pH of water from the granodioritic and felsic gneiss ranges from 5.4 to 7.9, and the median is 6.5. The observed values of pH for the granodioritic and felsic gneiss are evenly distributed about the median.

The specific conductance of water ranges from 60 to 3,900 μmho/cm, and the median is 210 μmho/cm. Only three samples exceed 500 μmho/cm, most likely because of site-specific contamination.

Table 27. *Summary of Water-Quality Data for Wells in the Granodioritic and Felsic Gneiss*

(Quantities are in milligrams per liter unless otherwise indicated)

Parameter	Number of samples	Range	Median
Hardness (as calcium carbonate)	66	32–3,300	86
pH (units)	67	5.4–7.9	6.5
Specific conductance (μmho/cm)	68	60–3,900	210
Nitrate (as nitrogen)	12	<.10–6.3	2.6
Calcium	13	11–140	23
Magnesium	13	3.3–41	9.0
Sodium	13	4.5–15	9.0
Potassium	13	1.3–17	2.3
Chloride	17	5.2–1,800	20
Sulfate	13	4.3–46	31
Total dissolved solids	13	85–929	190
Iron (μg/L)	13	<3–4,100	8
Lead (μg/L)	12	2–13	5
Manganese (μg/L)	12	<1–75	4
Nickel (μg/L)	12	1–7	3

Chloride concentrations range from 5.2 to 1,800 mg/L; the median is 20 mg/L. Only two samples tested have concentrations of chloride greater than the USEPA MCL of 250 mg/L. These concentrations are probably caused by site-specific contamination.

The water from 13 wells in the granodioritic and felsic gneiss was analyzed for iron. Iron ranges from less than 3 to 4,100 μg/L; the median is 8 μg/L. Water from two wells has concentrations above the USEPA SMCL of 300 μg/L.

Mafic Gneiss

Description

The mafic gneiss consists of dark medium-grained metamorphic rocks of early Paleozoic and/or Proterozoic Z age (wbma, wma, pma, and wmg on Plate 1) and Proterozoic Y age (Ybma and Ybmg). They are generally of gneissic texture and are either hornblende- or pyroxene-bearing. They are generally gray but can also be green, brown, or black. This lithology underlies approximately 11 percent of the county. In this report, all of the mafic gneisses are considered as one water-bearing unit.

Water-Bearing Characteristics

The hydrologic characteristics for wells in the mafic gneiss are summarized in Table 28. In Table 29, the cumulative frequency distributions of depths of wells, depths of well casings, depths to water, yields, and specific capacities are listed.

The reported depths of wells in mafic gneiss range from 38 to 361 feet below land surface, and the median is 146 feet. This is similar to the depths of wells in granodioritic and felsic gneiss. Ninety percent of the wells in the mafic gneiss are at least 58 feet deep. Seventy-five percent of the wells are less than 238 feet deep.

The reported depths of casings of wells in the mafic gneiss range from 16 to 105 feet below land

Table 28. *Summary of Hydrologic Characteristics for Wells in the Mafic Gneiss*

Hydrologic characteristic	Number of wells	Range	Median
Depth of well (feet)	58	38–361	146
Depth of well casing (feet)	54	16–105	40
Depth to water (feet)	53	2–180	25
Yield (gal/min)	55	.5–150	6
Specific capacity [(gal/min)/ft]	44	.002–6.0	.08

Table 29. *Cumulative Frequency Distributions of Reported Well Depths, Depths of Well Casings, Depths to Water, Yields, and Specific Capacities for Wells in the Mafic Gneiss*

Hydrologic characteristic	Number of wells	90 percent[1]	75 percent[1]	50 percent[1]	25 percent[1]	10 percent[1]
Depth of well (feet)	58	58	100	146	238	300
Depth of well casing (feet)	54	21	30	40	61	74
Depth to water (feet)	53	9	15	25	35	48
Yield (gal/min)	55	1	2	6	16	30
Specific capacity [(gal/min)/ft]	44	.01	.01	.08	.26	1.2

[1]Percentage of wells in which indicated value is equaled or exceeded.

surface, and the median is 40 feet. Seventy-five percent of the well casing depths are 30 feet or more below land surface; only 10 percent are 74 feet or deeper.

The reported depths to water for wells in the mafic gneiss range from 2 to 180 feet below land surface; the median is 25 feet. This is the second-greatest median depth to water for all of the water-bearing rock units in the county. In 90 percent of the wells, the depth to water is 9 feet or more below land surface. Depth to water is 48 feet or more for only 10 percent of the wells reported.

The reported yields of wells in the mafic gneiss range from 0.5 to 150 gal/min; the median is 6 gal/min. Only 10 percent of the reported well yields are 30 gal/min or greater. Twenty-five percent of the reported yields are less than 2 gal/min.

The specific capacities of wells in the mafic gneiss range from 0.002 to 6.0 (gal/min)/ft, and the median is 0.08 (gal/min)/ft. This is the lowest median specific capacity for any of the rock units in the county, although the medians for all other units were 0.2 (gal/min)/ft. Only 10 percent of the reported specific capacities for wells in the mafic gneiss are 1.2 (gal/min)/ft or greater.

Generally, the chances of finding water below 300 feet are low, but are better than for the other crystalline rocks (Table 16). The probability of obtaining a higher yield is increased by locating wells in valleys or draws. Wells can be expected to yield 10 gal/min and can yield up to 30 gal/min if properly located and developed.

Quality of Water

Water-quality data for wells in the mafic gneiss are summarized in Table 30. The hardness ranges from 17 to 240 mg/L; the median is 77 mg/L. Most of the samples are classified as soft to moderately hard. Only three samples are classified as hard and two samples are very hard.

The pH of water from the mafic gneiss ranges from 5.2 to 7.4, and the median is 6.4. The specific conductance ranges from 60 to 600 μmho/cm, and the median is 185 μmho/cm. All of these values are comparable to the other units in the county.

The water from six wells in the mafic gneiss was analyzed for trace metals. Iron concentrations range from 12 to 4,000 μg/L; the median is 90 μg/L. Water from two wells exceeds the USEPA SMCL for iron.

Table 30. *Summary of Water-Quality Data for Wells in the Mafic Gneiss*

(Quantities are in milligrams per liter unless otherwise indicated)

Parameter	Number of samples	Range	Median
Hardness (as calcium carbonate)	30	17–240	77
pH (units)	29	5.2–7.4	6.4
Specific conductance (µmho/cm)	30	60–600	185
Nitrate (as nitrogen)	6	.07–3.6	2.8
Calcium	6	8.0–36	16
Magnesium	6	6.0–12	7.7
Sodium	6	6.4–37	9.8
Potassium	6	.8–2.8	1.8
Chloride	6	9.6–100	24
Sulfate	6	1.0–40	25
Total dissolved solids	6	69–346	130
Iron (µg/L)	6	12–4,000	90
Lead (µg/L)	5	4–14	8
Manganese (µg/L)	5	1–95	16
Nickel (µg/L)	5	<1–3	2

Ultramafite

Description

Ultramafite is a magnesium-rich rock derived from pyroxenite and peridotite. The pyroxenite and peridotite were probably intruded into the Wissahickon Formation during the early Paleozoic or Proterozoic Z, then hydrothermally altered to ultramafite. The ultramafite is composed primarily of serpentine, which is a group of hydrous magnesium silicate minerals. It ranges in color from buff to emerald green, and can be various shades of gray or bluish gray. It generally has a greenish hue and commonly has an oily appearance.

The ultramafite is well jointed and fractured. The joints and fractures, which commonly are numerous and may extend to a considerable depth, may hold considerable volumes of water. These secondary openings are responsible for water storage and transport. Although the ultramafite is well jointed and fractured and is a soft building material, it is rather inert and resistant to ordinary chemical weathering. Therefore, it tends to form low hills and ridges. Areas underlain by ultramafite are characterized by thin, low-fertility soils. Typically, springs and areas of high-yielding wells may be found in valleys that bisect the hills and ridges and at contacts with other rock units.

Two large areas of ultramafite (wum on Plate 1) are present in central Delaware County near Lima and Larchmont. Numerous smaller exposures are present throughout the county, but are not significant as aquifers. Approximately 4 percent of the county is underlain by ultramafite.

Water-Bearing Characteristics

Well data for ultramafite are sparse. The ranges of well depths, depths of well casings, depths to water, yields, and specific capacities for nine wells completed in ultramafite are presented in Table 31. The range of well depths is narrow compared to the other major water-bearing rock units. Few shallow wells have been drilled in ultramafite. This may be the result of fracturing at depth, as suggested by the high values of depths of casings, which range from 43 to 90 feet below land surface. The median depth of casing, 62 feet, is deeper than that of the other rock units in the county and is probably indicative of the fractured nature of the rock rather than the depth of weathering.

The depths to water in ultramafite range from 5.0 to 40 feet below land surface; the median is 20.0 feet. This is shallow compared to the other rock units

Table 31. *Summary of Hydrologic Characteristics for Wells in the Ultramafite*

Hydrologic characteristic	Number of wells	Range	Median
Depth of well (feet)	9	80–340	117
Depth of well casing (feet)	8	43–90	62
Depth to water (feet)	8	5.0–40	20
Yield (gal/min)	9	2.0–60	18
Specific capacity [(gal/min)/ft]	8	.01–.6	.22

in the county, especially considering that seven of the eight wells in the data set were drilled on hillsides or hilltops.

The yields of wells in ultramafite range from 2.0 to 60 gal/min; the median is 18 gal/min. This is the second-highest median yield for all of the water-bearing units in the county. Most water-bearing zones encountered are less than 250 feet below land surface.

The specific capacities of wells in ultramafite range from 0.01 to 0.6 (gal/min)/ft, and the median is 0.22 (gal/min)/ft. This is comparable to the other major water-bearing rock units.

Wells should yield about 18 gal/min if properly located and developed, and specific capacities of about 0.2 (gal/min)/ft can be expected.

Quality of Water

Field determinations of hardness, pH, and specific conductance were made on five water samples from wells in ultramafite. A summary of field and laboratory analytical results of well water from ultramafite are given in Table 32. The hardness ranges from 68 to 190 mg/L; most of the water samples are classified as moderately hard. The pH ranges from 6.1 to 7.6; most of the samples are alkaline. The specific conductance ranges from 150 to 360 μmho/cm.

Magnesium concentrations range from 2.4 to 18 mg/L; these are the highest in the county and are caused by the high magnesium content of the rock.

Iron concentrations of three samples are 4, 5, and 5,400 μg/L; this last concentration exceeds the USEPA SMCL of 300 μg/L.

Wissahickon Formation

Description

The Wissahickon Formation consists of dark amphibolite, light augen gneiss, and quartz- and feldspar-rich and schistose members. It is the most prevalent rock unit at the surface in Delaware County. The Wissahickon is represented on Plate 1 by the symbols wb

Table 32. *Summary of Water-Quality Data for Wells in the Ultramafite*

(Quantities are in milligrams per liter unless otherwise indicated)

Parameter	Number of samples	Range/value
Hardness (as calcium carbonate)	5	68–190
pH (units)	5	6.1–7.6
Specific conductance (µmho/cm)	5	150–360
Nitrate (as nitrogen)	3	1.4–7.2
Calcium	3	4.2–8.9
Magnesium	3	2.4–18
Sodium	3	2.3–3.7
Potassium	3	.3–1.8
Chloride	3	8.1–11
Sulfate	3	3.2–26
Total dissolved solids	3	111–182
Iron (µg/L)	3	4–5,400
Lead (µg/L)	2	2–7
Manganese (µg/L)	2	<1–2
Nickel (µg/L)	2	2

and wp. It comprises approximately 34 percent of the exposed formations in Delaware County and underlies most of the unconsolidated deposits.

The Wissahickon Formation was originally sediment of variable thickness and composition. The original sediments have been completely recrystallized by metamorphism. The formation is highly variable in composition and degree of metamorphism. Its thickness is estimated to be 5,000 to 8,000 feet.

Water-Bearing Characteristics

The Wissahickon Formation is the most productive of the water-bearing rock units in Delaware County. Water is present in joint planes and locally in fault planes. Table 33 gives a summary of hydrologic characteristics of the Wissahickon Formation. Table 34 gives the cumulative frequency distributions of well depths, depths of well casings, depths to water, yields, and specific capacities for wells completed in the Wissahickon Formation.

Table 33. *Summary of Hydrologic Characteristics for Drilled Wells in the Wissahickon Formation*

Hydrologic characteristic	Number of wells	Range	Median
Depth of well (feet)	132	43–675	187
Depth of well casing (feet)	114	4–127	40
Depth to water (feet)	112	1–85	20
Yield (gal/min)	127	1–300	20
Specific capacity [(gal/min)/ft]	72	.004–2.9	.2

The reported depths of wells in the Wissahickon Formation range from 43 to 675 feet below land surface; the median is 187 feet. This is the greatest median depth of any of the major water-bearing rock units in Delaware County. More than 25 percent of the wells are deeper than 272 feet, and only 10 percent are less than 93 feet deep.

The reported depths of casings for wells in the Wissahickon Formation range from 4 to 127 feet below land surface, and the median is 40 feet. Although the maximum depth of casing is 127 feet, only 10 percent of well-casing depths are 70 feet or more below land surface.

The depths to water for wells in the Wissahickon Formation range from 1 to 85 feet below land surface; the median is 20 feet. Only 10 percent of the

Table 34. *Cumulative Frequency Distributions of Reported Well Depths, Depths of Well Casings, Depths to Water, Yields, and Specific Capacities for Wells in the Wissahickon Formation*

Hydrologic characteristic	Number of wells	90 percent[1]	75 percent[1]	50 percent[1]	25 percent[1]	10 percent[1]
Depth of well (feet)	133	93	122	187	272	451
Depth of well casing (feet)	114	21	30	40	49	70
Depth to water (feet)	112	6	11	20	35	50
Yield (gal/min)	127	5	10	20	40	65
Specific capacity [(gal/min)/ft]	72	.02	.06	.20	.45	.97

[1]Percentage of wells in which indicated value is equaled or exceeded.

depths to water are 50 feet or more below land surface, and 25 percent of the depths to water are less than 11 feet.

The yields of wells in the Wissahickon Formation range from 1 to 300 gal/min; the median yield is 20 gal/min. This is the highest median yield of the crystalline rock units in the county. The Wissahickon Formation has the greatest potential for providing a high-yielding well. Most of the water-bearing zones are penetrated within 300 feet of the land surface (Table 16). More than 90 percent of wells drilled in the Wissahickon Formation should provide 5 gal/min or more, which is adequate for domestic-supply purposes.

The specific capacities of wells in the Wissahickon Formation range from 0.004 to 2.9 (gal/min)/ft, and the median is 0.2 (gal/min)/ft. Except for the largest values, these specific capacities are similar to those of the granodioritic and felsic gneiss and mafic gneiss.

The probability of obtaining high yields is increased by locating wells in valleys or draws and by situating wells to take advantage of directions of groundwater flow due to schistosity. Wells can be expected to yield 20 gal/min and can yield up to 60 gal/min if properly located and developed.

Quality of Water

Water-quality data for wells in the Wissahickon Formation are summarized in Table 35. The hardness ranges from 17 to 220 mg/L; the median is 68 mg/L.

Table 35. *Summary of Water-Quality Data for Wells in the Wissahickon Formation*

(Quantities are in milligrams per liter unless otherwise indicated)

Parameter	Number of samples	Range	Median
Hardness (as calcium carbonate)	62	17–220	68
pH (units)	58	5.4–8.0	6.4
Specific conductance (µmho/cm)	64	55–2,200	220
Nitrate (as nitrogen)	14	<.10–6.7	1.1
Calcium	14	12–130	32
Magnesium	14	4.5–62	8.6
Sodium	14	4.8–98	21
Potassium	14	1.0–12	3.8
Chloride	14	4.8–650	40
Sulfate	14	12–94	42
Total dissolved solids	14	80–1,600	230
Iron (µg/L)	14	6–120,000	180
Lead (µg/L)	12	<1–11	3
Manganese (µg/L)	13	<1–13,000	100
Nickel (µg/L)	12	1–13	2

All but four samples from the Wissahickon Formation can be classified as soft to moderately hard.

The pH of water from wells in the Wissahickon Formation ranges from 5.4 to 8.0, and the median is 6.4. Although 8.0 is the highest pH measured in all the samples from the county, most of the samples from the Wissahickon Formation are acidic. Specific conductance ranges from 55 to 2,200 µmho/cm; the median is 220 µmho/cm. Seventeen of 64 samples have specific conductances greater than or equal to 300, indicating large amounts of dissolved constituents.

The Wissahickon Formation has the highest concentrations of sodium, which range from 4.8 to 98 mg/L and have a median value of 21 mg/L. Chloride concentrations range from 4.8 to 650 mg/L, and the median is 40 mg/L; these are the highest chloride concentrations in the county. Only two samples analyzed from the Wissahickon Formation have concentrations of chloride greater than the USEPA MCL of 250 mg/L. These concentrations are probably indicative of site-specific contamination resulting from human activities. Total dissolved solids range from 80 to 1,600 mg/L, and the median is 230 mg/L. Only one sample exceeded the USEPA SMCL of 500 mg/L for dissolved solids.

The water from 14 wells in the Wissahickon Formation was analyzed for trace-metal concentrations. Iron concentrations range from 6 to 120,000 µg/L; the median is 180 µg/L. Six of 14 samples analyzed for iron exceed the USEPA SMCL of 300 µg/L. Manganese concentrations range from 2 to 13,000 µg/L, and the median is 100 µg/L. Nine of 13 analyses for manganese exceed the USEPA SMCL of 50 µg/L.

SUMMARY

Delaware County lies mostly in the Piedmont physiographic province in southeastern Pennsylvania. The landscape is characterized by gently rolling hills and is drained by six major streams that flow from northwest to southeast following the general slope of the land. Five of these, Cobbs Creek, Darby Creek, Crum Creek, Ridley Creek, and Chester Creek drain to the Delaware River estuary. Brandywine Creek, after it enters the state of Delaware, flows to the Christina River, which flows to the estuary.

Precipitation is the source of both surface water and groundwater. Although long-term average monthly precipitation is fairly evenly distributed throughout the year, evapotranspiration and variations in the type of precipitation reduce the groundwater recharge during the late spring and summer months, while in-

creasing direct runoff to streams. Groundwater discharges to the streams as base flow. The average annual precipitation is 43.46 inches per year and the total estimated storage of the groundwater reservoir is about 30 inches.

The county is adequately supplied with water by the existing public water utilities. Almost 62 percent of the water supplied by these purveyors is imported from groundwater and surface-water sources outside the county.

Five major crystalline rock units and one unconsolidated unit underlie the county. Of the crystalline units, anorthositic gneiss yields too little water for industrial or public water supply. Three others, the granodioritic and felsic gneiss, the mafic gneiss, and the ultramafite, yield only small quantities of water. The Wissahickon Formation is the most productive crystalline rock unit; the median well yield of the Wissahickon is about 20 gal/min. Elevated manganese and iron concentrations in water from wells in the Wissahickon Formation limit its use for some industrial purposes.

The informally named Trenton gravel consists of unconsolidated sediments. Although short-term potential yields of this unit are high, the shallowness of the deposits and the possibility of salt-water intrusion from the Delaware River limit its use for public or large industrial supply.

Wells yielding 10 to 20 gal/min are possible in most areas. The probability of obtaining the highest yields generally is increased by locating wells in valleys or draws. The probability of obtaining high yields decreases with depth and relatively few water-bearing zones are penetrated at depths of more than 300 feet below land surface. The direction of groundwater flow, regional faulting, and depth of water-bearing zones in nearby wells also should be considered to insure maximum yields. Groundwater quality in the county is generally suitable for human consumption and most uses except where site-specific contamination has degraded the quality.

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GLOSSARY

Aquifer. A formation, group of formations, or a part of a formation that contains sufficient saturated, permeable material to yield usable quantities of water to wells and springs.

Base flow. Discharge entering stream channels as effluent from the groundwater reservoir; the fair-weather flow of streams.

Cubic feet per second. The discharge of a stream of rectangular cross section, 1 foot wide and 1 foot deep, whose velocity is 1 foot per second.

Direct runoff. The water that moves directly over the land surface to streams promptly after rainfall or snowmelt.

Discharge, groundwater. The process by which water is removed from the saturated zone; also the quantity of water removed.

Discharge, surface water. The volume of water (or more broadly, the volume of fluid plus suspended sediment) that passes a given point within a given period of time.

Drawdown. The lowering of the water table or potentiometric surface caused by pumping (or artesian flow).

Evapotranspiration. Water withdrawn from a land area by direct evaporation and by plant transpiration.

Formation. A fundamental unit in rock stratigraphic classification. It is a body of rock characterized by uniform rock characteristics; it is generally tabular and is mappable at the earth's surface, or traceable in the subsurface through borings.

Fracture. A break in rocks along which no displacement has occurred.

Hardness. A chemical property of water, caused mostly by the presence of calcium and magnesium, which increases the amount of soap needed to produce lather. Water having a hardness (calculated as milligrams per liter of calcium carbonate) less than 60 is soft; between 61 and 120 is moderately hard; between 121 and 180 is hard; and greater than 180 is very hard. Field-determined values reported in grains per gallon were converted to milligrams per liter by multiplying by 17.1.

Head, static. The height above a standard datum of the surface of a column of water that can be supported by the static pressure.

Hydraulic gradient. Change in static head per unit of distance in a given direction.

Hydrograph. A graph showing depth, flow, velocity, or other characteristics of water with respect to time.

Permeability. The capacity of a material to transmit a fluid.

pH. The negative logarithm of the hydrogen-ion activity. A pH of 7.0 indicates a neutral solution; values higher than 7.0 denote alkaline solutions; values lower than 7.0 indicate acidic solutions.

Porosity. The ratio of the total volume of openings in a rock to the total volume of the rock, expressed as a percentage.

Potentiometric surface. The surface that represents the static groundwater head; the potentiometric surface for an unconfined aquifer is the water table.

Primary porosity. Porosity due to openings or voids within the rock when it was formed. In sedimentary rocks, openings result from the arrangement and nature of the original sediment.

Recharge, groundwater. The process by which water is added to the saturated zone; also the quantity of water added.

Rock unit. Any mass of bedrock or unconsolidated material that has been mapped as an entity and

given a name; rock units have characteristic features that permit them to be separated from other rock units.

Runoff. That part of the precipitation that appears in streams. It is the same as streamflow unaffected by artificial diversions, storage, or other works of man in or on the stream channels.

Saturated zone. The zone in which interconnected openings are saturated with water.

Secondary porosity. Porosity due to voids produced in rocks, subsequent to their formation, by solution, weathering, or movement.

Specific capacity. The yield of a well divided by the drawdown necessary to produce this yield; expressed as gallons per minute per foot of drawdown.

Specific conductance. A measure of the ability of water to conduct an electrical current; conductance increases with increasing concentration of dissolved minerals.

Specific yield. The ratio of the volume of water that a saturated rock or soil will yield when drained by gravity to the volume of rock or soil.

Stream basin. An area that is drained by a stream and all of its tributaries.

Strike. The compass bearing of a horizontal line in the plane of an inclined surface.

Streamflow. The actual flow in streams, whether or not subject to regulation, or underflow.

Stream-gaging station. A gaging station where a record of discharge of a stream is obtained. Within the U.S. Geological Survey this term is used only for those gaging stations where a continuous record of discharge is obtained.

Surface water. Water on the surface of the earth.

Transpiration. The process by which vapor escapes from the living plant, principally the leaves, and enters the atmosphere.

Water table. The upper surface of an unconfined subsurface water body where the pressure is equal to that of one atmosphere.

Water year. The 12-month period of time beginning on October 1 and ending on September 30, designated by the calendar year in which it ends.

FACTORS FOR CONVERTING INCH-POUND UNITS TO INTERNATIONAL SYSTEM UNITS (SI)

Multiply inch-pound units	*By*	*To obtain SI units*
	Length	
inch (in.)	25.4	millimeter (mm)
foot (ft)	.3048	meter (m)
mile (mi)	1.6093	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
gallon (gal)	3.785	liter (L)
	Flow	
cubic foot per second (ft^3/s)	28.32	liter per second (L/s)
gallon per minute (gal/min)	.06308	liter per second (L/s)
million gallons per day (Mgal/day)	43.81	cubic decimeter per second (dm^3/s)
	Specific conductance	
micromhos (μmho)	1.0	microsiemens (μS)

Table 36. *Inorganic Analyses of Water*

(Quantities are in milligrams per

Well number	Date of sample	Geologic unit	pH (units)	Dissolved solids (residue at 180°C)	Silica (SiO_2)	Oxygen	Bicar-bonate (HCO_3)	Hard-ness ($CaCO_3$)	Hard-ness, noncar-bonate ($CaCO_3$)	Cyanide (CN)
De– 28	7–17–56	Qt	7.6	251	8.4	—	63	140	92	—
30	5–22–64	wb	7.0	150	15	—	120	110	9	—
33	5–26–64	Ybma	6.3	119	21	—	50	65	24	—
	7–22–83		6.0	150	23	—	49	83	43	<0.01
50	5–21–63	Ybfa	7.0	232	17	—	92	130	58	—
	7–22–83		6.5	206	15	—	110	120	28	—
82	5–17–63	Ybfa	7.2	131	28	—	63	66	15	—
	7–26–83		6.5	158	26	BD[1]	52	83	40	—
95	5–26–64	Ybfa	6.3	226	15	—	77	120	59	—
	7–15–83		6.0	187	16	—	72	110	46	—
116	9–26–25	Ybfa	—	150	34	—	23	68	50	—
	8– 5–83		6.0	191	28	—	51	94	53	—
136	9–26–25	wum	—	111	23	—	58	85	37	—
200	9–26–25	wan	—	140	36	—	56	65	19	—
356	9–26–25	wb	—	80	12	—	52	51	8	—
381	9–26–25	Ybfa	—	85	28	—	43	45	9	—
393	9–26–25	wmg	—	69	12	—	27	41	19	—
	8– 1–83		5.7	261	9.9	—	21	90	73	—
402	9–26–25	wmg	—	126	20	—	30	63	38	—
454	10–24–61	Ybfa	6.7	141	30	—	70	80	23	—
	2–14–67		7.3	138	24	—	72	81	22	—
	7–14–83		6.3	239	26	6.5	79	140	71	<.01
455	3–29–72	Ybfa	6.6	204	—	—	52	89	46	—
	7–29–83		6.4	156	26	—	60	87	38	—
466	6–12–80	wp	6.1	290	31	1.1	54	130	82	.01
	7–13–83		5.5	244	31	.7	37	91	61	<.01
501	7–28–83	wp	5.7	280	17	2.3	30	140	110	<.01
558	7–25–83	wmg	6.2	346	27	2.7	67	140	84	—
678	7–27–83	Ybfa	7.0	929	16	4.7	69	520	460	—
	12–20–83		6.6	—	—	—	76	—	—	—
680	7–15–83	Ybfa	6.7	204	26	6.3	76	110	49	—
694	7–14–83	wum	5.8	182	23	3.7	93	120	43	—
720	12– 8–83	wum	6.3	116	31	—	71	88	30	—
723	8– 3–83	Ybfa	6.4	190	26	9.9	40	100	67	<.01
748	8– 5–83	Ybfa	5.8	120	20	8.4	26	55	34	—
763	7–13–83	wp	5.7	369	31	4.4	56	150	110	<.01
772	12– 7–83	Ybfg	6.3	90	21	—	41	46	12	<.01
802	12– 7–83	Ybmg	6.0	115	27	—	54	55	12	<.01
803	7–21–83	wb	5.4	165	18	7.8	18	61	46	—
815	12– 7–83	Ybfg	5.5	109	18	—	27	60	38	<.01
830	7–28–83	wp	5.8	1,600	6.8	BD[1]	120	580	480	<.01
834	12– 9–83	wp	6.0	322	44	—	110	160	70	<.01
836	12– 9–83	wp	6.4	309	22	—	140	130	21	<.01
839	7–27–83	Ybfa	5.9	—	—	—	—	—	—	—
	12–16–83		5.8	—	—	—	32	—	—	—
840	7–27–83	Ybfa	5.7	—	—	—	—	—	—	—
	12–16–83		6.2	—	—	—	110	—	—	—
841	12–15–83	Ybfa	6.2	—	—	—	37	—	—	—
842	8– 2–83	Ybfa	7.4	—	—	—	—	—	—	—
	12–15–83		6.0	—	—	—	27	—	—	—
844	8– 4–83	wmg	5.2	133	14	1.2	9.8	45	37	<.01
867	12–15–83	wp	6.1	197	16	—	46	110	70	<.01
869	12– 8–83	wp	—	—	—	—	—	—	—	<.01
	12– 8–83		6.7	114	18	—	39	53	21	—
874	12– 8–83	wp	6.8	204	16	—	85	110	41	—
881	8– 4–83	wp	6.0	248	27	3.1	56	130	82	<.01
882	12–15–83	wp	7.2	215	31	—	110	110	21	<.01

[1]BD, barely detectable.

from Selected Wells in Delaware County

liter unless otherwise indicated)

Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Iron (Fe) (µg/L)	Manganese (Mn) (µg/L)	Methylene blue active substance	Well number
33	15	—	—	79	BD[1]	0.1	340	BD[1]	—	De– 28
28	10	4.8	1.0	12	6.3	<.1	60	BD[1]	BD[1]	30
17	5.4	6.7	1.5	28	3.3	.1	130	BD[1]	BD[1]	33
19	8.7	7.0	1.6	26	13	.2	22	1	—	
32	13	15	6.0	50	14	.1	160	BD[1]	0.12	50
29	12	9.0	17	46	8.1	.2	6	<1	—	
19	4.6	4.5	20	19	5.6	.0	2,500	90	.06	82
21	7.4	5.3	3.3	31	25	.1	3,000	75	—	
29	12	15	1.7	47	14	.1	170	BD[1]	.04	95
24	11	13	1.6	33	10	<.1	7	2	—	
16	6.9	6.8	1.9	14	6.2	—	80	—	—	116
23	9.0	15	1.4	34	21	.1	6	<1	—	
4.2	18	2.6	.80	3.2	11	—	5,400	—	—	136
14	7.4	8.6	1.5	4.6	12	—	210	—	—	200
12	5.1	6.5	1.7	13	4.8	—	870	—	—	356
11	4.2	5.8	1.4	4.3	5.2	—	4,100	—	—	381
7.2	5.6	3.6	1.0	8.8	5.5	—	150	—	—	393
18	11	37	1.9	24	82	<.1	61	11	—	
14	6.7	6.4	2.2	40	9.6	—	4,000	—	—	402
20	7.3	6.7	2.5	25	6.4	.1	60	BD[1]	—	454
21	7.0	6.2	3.0	28	5.7	.1	1,200	BD[1]	—	
33	13	9.3	3.5	40	27	<.1	<3	4	—	
—	—	—	—	52	25	<.1	240	10	—	455
19	9.5	6.2	2.4	44	10	<.1	85	4	—	
32	11	50	6.5	47	55	.1	1,600	160	—	466
22	8.8	33	4.0	54	52	<.1	720	98	—	
28	16	13	8.7	72	46	<.1	15	170	—	501
36	12	37	2.8	17	100	<.1	12	19	—	558
140	41	11	6.5	31	350	<.1	25	<1	—	678
—	—	—	—	—	510	—	—	—	—	
31	8.2	9.1	2.3	18	29	<.1	<3	<1	—	680
8.2	24	3.7	1.8	26	9.0	<.1	5	2	—	694
8.9	16	2.3	.30	3.6	8.1	<.1	4	<1	—	720
25	9.2	9.5	1.6	38	15	<.1	12	8	—	723
12	6.0	5.2	1.3	17	7.2	<.1	7	4	—	748
42	12	27	4.3	36	81	<.1	250	160	—	763
13	3.3	4.7	2.1	5.1	8.0	<.1	18	4	—	772
12	6.2	8.6	1.5	7.9	12	.1	800	16	—	802
14	6.3	28	2.8	35	45	.1	13	96	—	803
13	6.7	6.9	2.8	11	25	<.1	8	16	—	815
130	62	98	12	66	650	.1	120,000	13,000	—	830
37	16	23	5.5	94	43	.1	19,000	870	—	834
39	8.5	46	4.0	53	50	.2	680	120	—	836
—	—	—	—	—	22	—	—	—	—	839
—	—	—	—	—	19	—	—	—	—	
—	—	—	—	—	20	—	—	—	—	840
—	—	—	—	—	43	—	—	—	—	
—	—	—	—	—	1,800	—	—	—	—	841
—	—	—	—	—	19	—	—	—	—	842
—	—	—	—	—	20	—	—	—	—	
8.0	6.0	11	.80	1.0	36	<.1	110	95	—	844
25	11	14	4.7	40	38	<.1	6	2	—	867
—	—	—	—	—	—	—	—	—	—	869
12	5.6	8.2	3.5	30	6.1	<.1	25	47	—	
37	4.5	19	3.3	44	25	.4	100	100	—	874
37	8.5	15	2.6	48	33	<.1	19	2	—	881
37	5.0	23	3.6	31	27	.3	1,100	530	—	882

Table 37. *Analyses of Nutrients in Water from Selected Wells in Delaware County*

(Quantities are in milligrams per liter)

Well number	Date of sample	Geologic unit	Nitrite (NO_2), as N	Nitrate (NO_3), as N	Ortho-phos-phorus, as P
De– 28	7–17–56	Qt	—	4.7	—
30	5–22–64	wb	—	.97	—
33	5–26–64	Ybma	—	1.8	—
	7–22–83		<0.010	3.4	0.020
50	5–21–63	Ybfa	—	6.3	—
	7–22–83		<.010	2.6	.030
82	5–17–63	Ybfa	—	.25	—
	7–26–83		<.010	<.10	<.010
95	5–26–64	Ybfa	—	7.9	—
	7–15–83		<.010	5.4	.030
116	9–26–25	Ybfa	—	13	—
	8– 5–83		.020	3.9	.040
136	9–26–25	wum	—	7.2	—
200	9–26–25	wan	—	5.9	—
356	9–26–25	wb	—	.10	—
381	9–26–25	Ybfa	—	2.5	—
393	9–26–25	wmg	—	3.2	—
	8– 1–83		<.010	3.6	<.010
402	9–26–25	wmg	—	.07	—
454	10–24–61	Ybfa	—	1.4	—
	2–14–67		—	.57	—
	7–14–83		<.010	.36	<.010
455	3–29–72	Ybfa	—	3.2	.070
	7–29–83		<.010	1.5	.020
466	6–12–80	wp	.000	.12	.020
	7–13–83		<.010	<.10	<.010
501	7–28–83	wp	<.010	6.7	.020
558	7–25–83	wmg	<.010	2.2	<.010
678	7–27–83	Ybfa	<.010	1.8	<.010
680	7–15–83	Ybfa	<.010	2.4	.010
694	7–14–83	wum	<.010	1.4	.060
720	12– 8–83	wum	<.010	4.9	.010
723	8– 3–83	Ybfa	.050	6.3	.010
748	8– 5–83	Ybfa	.030	4.1	.020
763	7–13–83	wp	<.010	3.5	.030
772	12– 7–83	Ybfg	.020	3.6	.010
802	12– 7–83	Ybmg	<.010	1.1	<.010
803	7–21–83	wb	<.010	2.7	.020
830	7–28–83	wp	.010	<.10	<.010
834	12– 9–83	wp	<.010	2.7	.030
836	12– 9–83	wp	<.010	1.2	.020
844	8– 4–83	wmg	.040	2.1	<.010
867	12–15–83	wp	<.010	2.9	.080
869	12– 8–83	wp	<.010	<.10	<.010
874	12– 8–83	wp	<.010	.11	.010
881	8– 4–83	wp	.020	3.9	.040
882	12–15–83	wp	<.010	<.10	.020

Table 38. *Analyses of Trace Metals in Water from Selected Wells in Delaware County*

(Quantities are in micrograms per liter)

Well number	Date of sample	Time	Geologic unit	Arsenic (As)	Chromium, hexavalent (Cr)	Lead (Pb)	Nickel (Ni)
De– 33	7–22–83	0950	Ybma	1	<1	14	3
50	7–22–83	1330	Ybfa	<1	<1	13	2
82	7–26–83	1115	Ybfa	<1	<1	2	5
95	7–15–83	1415	Ybfa	1	<1	9	2
116	8– 5–83	1400	Ybfa	<1	<1	4	3
393	8– 1–83	1325	wmg	<1	<1	5	2
454	7–14–83	1045	Ybfa	1	<1	5	3
455	7–29–83	1035	Ybfa	<1	<1	2	7
466	6–12–80	0945	wp	<50	—	0	20
	7–13–83	0950		1	<1	3	5
501	7–28–83	1115	wp	<1	<1	4	5
558	7–25–83	1150	wmg	1	<1	12	1
678	7–27–83	1355	Ybfa	<1	<1	6	5
680	7–15–83	1055	Ybfa	1	<1	8	2
694	7–14–83	1340	wum	1	<1	7	2
720	12– 8–83	1030	wum	1	<1	2	2
723	8– 3–83	1140	Ybfa	1	<1	6	5
748	8– 5–83	1135	Ybfa	<1	<1	3	3
763	7–13–83	1410	wp	1	<1	6	1
772	12– 7–83	1415	Ybfg	1	<1	4	1
802	12– 7–83	1315	Ybmg	1	<1	4	2
803	7–21–83	1305	wb	1	<1	11	4
815	12– 7–83	1050	Ybfg	1	<1	5	1
830	7–28–83	1525	wp	<1	<1	6	13
834	12– 9–83	1240	wp	1	<1	8	3
836	12– 9–83	0930	wp	1	<1	3	1
844	8– 4–83	1505	wmg	<1	<1	8	3
867	12–15–83	1415	wp	<1	<1	<1	1
869	12– 8–83	1330	wp	1	<1	2	1
874	12– 8–83	1145	wp	1	<1	3	7
881	8– 4–83	1130	wp	<1	<1	2	1
882	12–15–83	1220	wp	<1	<1	2	1

Table 39. *Organic Analyses of Water*

(Quantities are in

Well number	Date of sample	Time	Geologic unit	Di-chloro-bromo-methane	Carbon tetra-chloride	1,2-Di-chloro-ethane	Bromo-form	Chloro-dibromo-methane	Chloro-form	Phenols	Toluene	Benzene	Chloro-benzene	Chloro-ethane	Ethyl-benzene	Methyl bromide
De–33	7–22–83	0950	Ybma	<1 0	<1.0	<1.0	<1.0	<1.0	<1	<1	3.0	<1.0	<1.0	<1.0	<1.0	<1.0
50	7–22–83	1330	Ybfa	—	—	—	—	—	—	<1	—	—	—	—	—	—
82	7–26–83	1115	Ybfa	—	—	—	—	—	—	<1	—	—	—	—	—	—
95	7–15–83	1415	Ybfa	—	—	—	—	—	—	<1	—	—	—	—	—	—
116	8– 5–83	1400	Ybfa	—	—	—	—	—	—	<1	—	—	—	—	—	—
393	8– 1–83	1325	wmg	—	—	—	—	—	—	<1	—	—	—	—	—	—
454	7–14–83	1045	Ybfa	<1.0	<1.0	<1.0	<1.0	<1.0	<1	<1	2.0	<1.0	<1.0	<1.0	<1.0	<1.0
455	7–29–83	1035	Ybfa	—	—	—	—	—	—	<1	—	—	—	—	—	—
466	6–12–80	0945	wp	<.10	<.10	<.10	<.10	<.10	0	0	—	—	<.10	—	—	—
	7–13–83	0950		<1.0	<1.0	<1.0	<1.0	<1.0	<1	<1	2.0	<1.0	<1.0	<1.0	<1.0	<1.0
501	7–28–83	1115	wp	<1.0	<1.0	<1.0	<1.0	<1.0	<1	<1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
558	7–25–83	1150	wmg	—	—	—	—	—	—	<1	—	—	—	—	—	—
678	7–27–83	1355	Ybfa	<1.0	<1.0	<1.0	<1.0	<1.0	<1	<1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
680	7–15–83	1055	Ybfa	—	—	—	—	—	—	<1	—	—	—	—	—	—
694	7–14–83	1340	wum	—	—	—	—	—	—	<1	—	—	—	—	—	—
720	12– 8–83	1030	wum	—	—	—	—	—	—	<1	—	—	—	—	—	—
723	8– 3–83	1140	Ybfa	—	—	—	—	—	—	15	—	—	—	—	—	—
748	8– 5–83	1135	Ybfa	—	—	—	—	—	—	<1	—	—	—	—	—	—
763	7–13–83	1410	wp	<1.0	<1.0	<1.0	<1.0	<1.0	<1	<1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
772	12– 7–83	1415	Ybfg	<3.0	<3.0	<3.0	<3.0	<3.0	<3	<1	<3.0	<3.0	<3.0	—	<3.0	—
802	12– 7–83	1315	Ybmg	<3.0	<3.0	<3.0	<3.0	<3.0	<3	<1	<3 0	<3.0	<3.0	—	<3.0	—
803	7–21–83	1305	wb	—	—	—	—	—	—	<1	—	—	—	—	—	—
815	12– 7–83	1050	Ybfg	<3.0	<3.0	<3.0	<3.0	<3.0	<3	<1	<3.0	<3.0	<3.0	—	<3.0	—
830	7–28–83	1525	wp	<1.0	<1.0	<1.0	<1.0	<1.0	<1	<1	<1.0	2.0	2.0	<1.0	<1.0	<1.0
834	12– 9–83	1240	wp	<3.0	<3.0	<3.0	<3.0	<3.0	<3	<1	<3.0	<3.0	<3.0	—	<3.0	—
836	12– 9–83	0930	wp	<3.0	<3.0	<3.0	<3.0	<3.0	<3	<1	<3.0	<3.0	<3.0	—	<3.0	—
844	8– 4–83	1505	wmg	<1.0	<1.0	18	<1.0	<1.0	<1	2	3.0	260	<1.0	<1.0	<1.0	<1.0
867	12–15–83	1415	wp	<3.0	<3.0	<3.0	<3.0	<3.0	<3	2	3.8	<3.0	<3.0	—	<3.0	—
869	12– 8–83	1300	wp	<3.0	<3.0	<3.0	<3.0	<3.0	<3	—	<3.0	<3.0	<3.0	—	<3.0	—
	12– 8–83	1330		—	—	—	—	—	—	<1	—	—	—	—	—	—
874	12– 8–83	1145	wp	—	—	—	—	—	—	<1	—	—	—	—	—	—
881	8– 4–83	1130	wp	<1.0	<1.0	<1.0	<1.0	<1.0	<1	<1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
882	12–15–83	1220	wp	<3.0	<3.0	<3.0	<3.0	<3.0	<3	<1	3.3	<3.0	<3.0	—	<3.0	—

from Selected Wells in Delaware County

micrograms per liter)

Methylene chloride	Tetra-chloro-ethylene	Tri-. chloro-fluoro-methane	1,1-Di-chloro-ethane	1,1-Di-chloro-ethylene	1,1,1-Tri-chloro-ethane	1,1,2-Tri-chloro-ethane	1,1,2,2-Tetra-chloro-ethane	1,2-Di-chloro-propane	1,2-Transdi-chloro-ethylene	1,3-Di-chloro-propene	2-Chloro-ethyl-vinyl-ether	Dichloro-difluoro-methane	Vinyl chloride	Tri-chloro-ethylene	Well number
<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	De– 33
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	50
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	82
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	95
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	116
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	393
<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	454
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	455
<.10	1.1	—	—	—	.80	—	—	<.10	—	—	—	—	—	7.7	466
<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	5.0	
<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	501
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	558
<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	678
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	680
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	694
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	720
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	723
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	748
<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	763
<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	—	—	<3.0	—	<3.0	772
<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	—	—	<3.0	—	<3.0	802
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	803
5.9	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	—	—	<3.0	—	<3.0	815
<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	11	<1.0	<1.0	<1.0	<1.0	<1.0	830
5.7	13	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	5.8	—	—	<3.0	—	4.2	834
<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	—	—	<3.0	—	<3.0	836
<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	844
<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	—	—	<3.0	—	<3.0	867
<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	—	—	<3.0	—	<3.0	869
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	874
<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	881
<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	—	—	<3.0	—	<3.0	882

Table 40. *Record*

Well location: The number is that assigned to identify the well. It is prefixed by the two-letter abbreviation of the county. The lat-long is the coordinates, in degrees, minutes, and seconds, of the well.

Use: C, commercial; E, power; F, fire; H, domestic; I, irrigation; N, industrial; P, public supply; R, recreation; T, institution; U, unused.

Topographic setting: F, flat; H, hilltop; S, hillside; T, terrace; V, valley; W, upland draw.

Aquifer: Qt, Trenton gravel; wan, anorthositic gneiss; gr, granodioritic gneiss; wb, wp, Wissahickon Formation; wbma, wma, pma, mafic gneiss, hornblende-bearing; wmg, mafic gneiss, pyroxene-bearing; wum, ultramafite; Ybfa, Proterozoic Y felsic gneiss, hornblende-bearing; Ybfg, Proterozoic Y felsic gneiss, pyroxene-bearing; Ybma, Proterozoic Y mafic gneiss, hornblende-bearing; Ybmg, Proterozoic Y mafic gneiss, pyroxene-bearing.

Well location		Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Number	Lat–Long							
De– 3	395040–753418	H. W. Ebert	—	—	U	280	S	wb/sch
15	395103–752147	Spencer Printing Co.	Frank S. Wiley	1929	U	20	V	wp/sch
16	395105–752203	Chester Hospital	do.	1925	U	10	V	wp/sch
17	395105–752207	do.	do.	1930	U	10	V	wp/sch
18	395102–752108	Aberfoyle Manufacturing Co.	Ridpath and Potter Co.	1942	U	8	V	wp/sch
20	395148–751734	U. S. Navy	do.	1945	U	14	V	wp/sch
28	395213–751720	Andrew Sakos	—	1931	U	20	V	Qt/sg
29	395140–751818	Corinthian Yacht Club	—	—	U	10	V	Qt/sg
30	400303–752239	Valley Forge Military Academy	Thomas G. Keyes	1962	R	328	V	wb/sch
33	395243–753431	H. F. Jones	Clifford S. Meyers	1955	H	360	H	Ybma/gn
45	395404–753216	Brinton Lea lot 5	John R. Turk	1961	H	400	S	Ybfa/gn
50	395425–753230	C. K. Sloan	Thomas G. Keyes	1963	H	415	W	Ybfa/gn
60	395514–753128	Charles Brown	do.	1963	H	360	S	Ybfa/gn
82	395540–753055	Daniel Dezmelyk	do.	1963	H	355	W	Ybfa/gn
95	395246–753037	Joseph Masccaro	Frank S. Wiley	1924	H	295	W	Ybfa/gn
105	395631–751559	Candy Crafters, Inc.	Ridpath and Potter Co.	1931	U	125	F	wp/sch
108	395023–752203	Ford Motor Co.	do.	1943	U	10	V	wp/sch
111	395044–752148	Penn Ice Works	Thomas B. Harper	1910	U	15	V	wp/sch
113	395053–752143	Edgemont Beef Co.	—	1931	U	20	V	wp/sch
114	395140–752133	W. H. Crystle Dairy	Conner and Magee	1931	U	70	H	wp/sch
116	395220–753528	Chadds Ford Hotel	—	—	C	172	V	Ybfa/gn
122	395536–751610	Fitzgerald Mercy Hospital	Conner and Magee	1933	U	100	S	wp/sch
123	395536–751608	do.	do.	1933	U	100	S	wp/sch
124	395614–751553	Crucible Steel Cast Co.	Quinn and Herron	1910	U	110	F	wp/sch
130	395524–751526	Cavalier FNC Supply	—	—	U	80	F	wp/sch
136	395124–753213	Methodist Church	—	—	U	400	H	wum/ser
141	395056–752104	Sun Ship Building Co.	—	—	U	5	V	wp/sch
144	395210–751650	Lester Piano Co.	John Rulon	1914	U	15	V	Qt/sg
145	395210–751650	do.	Thomas B. Harper	1905	U	15	V	wp/sch
146	395210–751650	do.	John Rulon	1915	U	15	V	wp/sch
147	395210–751650	do.	do.	1914	U	15	V	Qt/sg
148	395210–751650	do.	do.	1914	U	15	V	Qt/sg
149	395210–751650	do.	do.	1914	U	15	V	Qt/sg
150	395210–751650	do.	do.	1915	U	15	V	wp/sch
155	395208–752008	Thomas Leiper School	Thomas B. Harper	1904	U	45	V	wp/sch
175	395724–751459	Western Ice Co.	Quinn and Herron	1909	U	70	V	gr/gn
176	395724–751459	do.	do.	1909	U	70	V	gr/gn
177	395748–751457	Millbourne Mills Co.	—	—	U	90	V	wp/sch
200	394955–752627	H. F. Brown	W. H. Brown	1925	H	100	H	wan/gn
244	400258–752103	Sun Co., Inc.	—	—	H	345	S	Ybfg/gn
339	395445–751535	Darby Ice Plant	Quinn and Herron	1906	U	15	V	wp/sch

of Selected Wells

Lithology: gn, gneiss; phy, phyllite; sch, schist; ser, serpentinite; sg, sand and gravel.

Static water level: Date measured—month/last two digits of year.

Reported yield: gal/min, gallons per minute.

Specific capacity: (gal/min)/ft—gallons per minute per foot of drawdown.

Hardness: mg/L, milligrams per liter.

Specific conductance: µmho/cm at 25°C, micromhos per centimeter at 25 degrees Celsius.

Total depth below land surface (feet)	Casing		Depth(s) to water-bearing zone(s) (feet)	Static water level		Reported yield (gal/min)	Specific capacity [(gal/min)/ft]	Hardness (mg/L)	Specific conductance (µmho/cm at 25°C)	pH (units)	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
22	22	42	—	16	8/50	—	—	—	—	—	De– 3
150	—	8	—	—	—	—	—	—	—	—	15
—	—	4	—	—	—	7	—	—	—	—	16
500	—	8	—	—	—	—	—	—	—	—	17
130	28	8	—	8	3/42	75	1.0	—	—	—	18
300	42	10	—	12	5/45	300	.55	—	—	—	20
16	16	30	—	12	7/56	200	—	—	—	—	28
20	20	72	—	10	7/56	—	—	—	—	—	29
396	31	10	230	1	5/62	100	—	120	260	—	30
103	54	6	—	—	—	16	—	120	210	6.0	33
74	53	6	—	—	—	6	—	—	—	—	45
96	32	5	—	25	5/63	10	1.6	150	350	6.5	50
43	23	6	23;35	12	11/63	50	—	—	160	6.0	60
202	30	6	—	26	4/63	3	.08	100	240	6.5	82
50	—	6	—	15	—	15	—	140	200	6.0	95
180	30	8	—	10	1/31	90	—	—	—	—	105
80	33	8	—	11	12/43	36	.57	—	—	—	108
317	4	8	—	1	1/10	67	—	—	—	—	111
110	11	6	—	18	1/31	23	—	—	—	—	113
250	22	6	—	—	—	20	—	—	—	—	114
67	—	6	—	—	—	22	—	140	250	6.0	116
300	30	8	—	24	5/83	30	—	—	—	—	122
556	30	8	—	30	1/33	40	—	—	—	—	123
300	—	8	—	22	1/10	25	—	—	—	—	124
145	20	6	—	11	5/83	50	—	—	—	—	130
85	—	6	—	—	—	7	—	190	360	7.2	136
152	—	8	—	—	—	—	—	—	—	—	141
51	19	8	—	13	1/14	85	—	—	—	—	144
504	55	8	—	—	—	13	—	—	—	—	145
100	—	8	—	—	—	30	—	—	—	—	146
40	—	8	—	—	—	—	—	—	—	—	147
44	—	8	—	—	—	50	—	—	—	—	148
40	20	8	—	15	1/14	55	—	—	—	—	149
100	—	8	—	—	—	40	—	—	—	—	150
104	38	6	—	9	1/04	22	—	—	—	—	155
238	—	8	—	35	1/09	14	—	—	—	—	175
239	—	8	—	40	1/09	14	—	—	—	—	176
600	—	—	—	—	—	50	—	—	—	—	177
49	31	6	—	35	7/25	1	—	—	—	—	200
120	—	—	—	—	—	—	—	—	—	—	244
250	—	6	—	60	1/06	20	—	—	—	—	339

Table 40.

Well location		Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Number	Lat–Long							
De–356	395120–753230	Frank Rawlings	—	—	H	400	S	wb/sch
381	395228–753242	W. C. Walton	—	—	H	360	S	Ybfa/gn
393	395022–752937	G. A. Zebley	—	—	H	380	S	wmg/gn
402	395205–752542	James Harper	W. H. Brown	—	H	216	H	wmg/gn
446	400254–752107	Paul Van Dyke	Ridpath and Potter Co.	1946	H	410	S	Ybfg/gn
453	395623–751544	Lansdowne Ice and Coal Co.	John Rulon	1921	U	110	F	wp/sch
454	395758–752820	U. S. Army	—	1950	—	240	S	Ybfa/gn
455	395547–752806	Sleighton School	Thomas G. Keyes	1964	T	345	H	Ybfa/gn
458	395712–751657	St. Vincent's Home	Ridpath and Potter Co.	1928	U	200	H	wp/sch
459	395616–751554	Kevorkian and Groves	John Rulon	1950	U	110	F	wp/sch
460	395613–751550	do.	do.	1950	U	110	F	wp/sch
461	395348–751547	Philadelphia Brick Co.	Ridpath and Potter Co.	1927	U	30	V	wp/sch
464	395745–751519	Amoco	do.	1948	U	125	H	gr/gn
466	395630–751448	Chester Holding Corp.	do.	1953	C	80	V	wp/sch
468	395613–751611	do.	do.	1952	—	115	F	wp/sch
469	395743–751455	Victory Stone Co.	do.	1943	U	60	V	wp/sch
470	395708–752122	SS. Peter and Paul Cemetery	do.	1949	H	345	F	wp/sch
481	395447–751703	St. Joseph's Church	do.	1935	U	100	F	wp/sch
482	395734–751533	do.	do.	1934	—	130	H	gr/gn
484	395618–751600	Kevorkian and Groves	John Rulon	1950	U	110	F	wp/sch
486	395043–752219	Baldt, Inc.	Ridpath and Potter Co.	1942	U	40	V	wp/sch
489	395621–751559	Hajoca Corp.	do.	1942	U	115	F	wp/sch
491	395103–752140	Speare Department Store	do.	1936	U	25	V	wp/sch
501	395545–751444	Steven Mancini	Philadelphia Drilling	1949	H	60	S	wp/sch
510	395326–751642	Sharp and Dohme, Inc.	John Rulon	1946	U	30	V	wp/sch
511	395326–751642	do.	do.	1946	U	30	V	wp/sch
512	395038–752125	Scott Paper Co.	Layne-New York Co., Inc.	1931	U	5	V	Qt/sg
513	395037–752122	do.	do.	1931	U	5	V	Qt/sg
519	395124–753532	Ford Draper	Leroy Walton Corp.	1976	H	250	S	wb/sch
520	395121–753528	Avery Draper	do.	1976	H	190	W	wb/sch
521	395135–753352	James Potter	R. Walter Slauch and Sons	1975	H	405	H	wb/sch
522	395144–753350	Joseph Orlando	Thomas G. Keyes	1973	H	380	H	wb/sch
523	395202–753347	Roger Voter	do.	1968	H	325	H	wb/sch
524	395217–753345	William Dupoint	do.	1969	H	320	S	wb/sch
525	395212–753354	Davis	—	—	H	230	S	wb/sch
526	395127–753318	Walter Hunter	—	—	H	375	S	wb/sch
528	395236–753455	Roy Detweller	Thomas G. Keyes	1973	H	260	S	Ybfa/gn
529	395114–753524	C. Simonds	Leroy Walton Corp.	1976	H	235	S	wb/sch
530	395023–753536	G. Weymouth	—	—	H	150	T	wb/sch
531	395146–753459	C. Larzelera	Thomas G. Keyes	1978	H	325	H	wbma/gn
532	395141–753411	Roy Weston	do.	1969	H	335	S	wb/sch
534	395102–753325	B. May	Kenneth L. Madron	1981	H	300	F	wb/sch
535	395112–753313	E. Raak	do.	1981	H	295	V	wb/sch
536	395125–753308	S. Moore	do.	1982	H	360	W	wb/sch
537	395201–753402	Donald Weiss	Thomas G. Keyes	1980	H	245	S	wb/sch
538	395115–753304	Salem Contractor	Kenneth L. Madron	1981	H	290	V	wb/sch
539	395043–753232	F. Thompson	Thomas G. Keyes	1978	H	395	F	wb/sch

(Continued)

Total depth below land surface (feet)	Casing Depth (feet)	Casing Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level Depth below land surface (feet)	Static water level Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity [(gal/min)/ft]	Hard-ness (mg/L)	Specific conduc-tance (μmho/cm at 25°C)	pH (units)	Well number
106	—	6	—	—	—	20	—	—	—	—	De–356
51	—	6	—	—	—	30	—	—	—	—	381
38	—	6	—	29	—	2	—	120	380	5.7	393
75	—	6	35	35	—	65	2.2	—	—	—	402
160	—	—	—	—	—	10	—	—	—	—	446
600	—	6	—	—	—	20	—	—	—	—	453
160	—	—	—	28	2/83	19	—	170	390	6.3	454
220	48	6	—	14	4/64	50	.48	140	230	6.4	455
300	12	10	—	21	6/28	40	.34	—	—	—	458
100	32	8	—	9	6/83	40	.63	—	—	—	459
100	18	8	—	6	11/50	40	.62	—	—	—	460
518	96	6	—	26	6/34	30	.37	—	—	—	461
300	23	8	—	30	4/48	23	.20	—	—	—	464
500	66	8	—	40	12/78	200	—	120	320	5.5	466
91	—	—	—	—	—	30	—	—	—	—	468
200	27	6	—	7	9/51	33	1.0	—	—	—	469
209	26	6	—	4	7/49	27	1.5	68	240	7.0	470
607	127	6	—	11	1/35	3	—	—	—	—	481
250	25	8	—	20	9/34	10	.11	—	—	—	482
200	34	6	—	14	10/50	55	2.0	—	—	—	484
197	37	6	—	22	12/42	40	2.9	—	—	—	486
258	42	8	—	16	10/42	8	.07	—	—	—	489
219	74	6	—	20	7/36	30	.38	—	—	—	491
175	29	6	—	9	12/49	6	.06	190	410	—	501
500	13	6	—	2	11/46	15	—	—	—	—	510
228	26	12	—	3	8/46	7	—	—	—	—	511
48	—	—	—	—	—	11	—	—	—	—	512
50	—	—	—	—	—	200	—	—	—	—	513
440	75	6	240;430	36	6/76	40	.24	68	180	7.8	519
460	80	6	315;440	1	6/76	12	.06	68	170	7.8	520
132	39	6	50;100	30	11/75	2	.02	51	160	6.4	521
75	39	6	26;31;41;46	28	1/73	20	.43	51	150	6.1	522
135	—	6	120;137	85	9/68	5	.06	51	180	5.9	523
125	30	6	72;93;114	50	4/69	60	.83	51	150	6.8	524
—	—	—	—	17	5/82	—	—	51	160	7.9	525
—	—	—	—	—	—	—	—	68	170	6.0	526
190	28	6	46;135;180	35	6/82	50	.36	86	220	6.2	528
440	60	6	150;420	72	6/82	40	.29	51	140	6.6	529
—	—	—	—	—	—	—	—	100	260	6.7	530
200	28	6	50;180	28	6/78	1	.01	—	—	—	531
170	26	6	80;140;156	46	6/82	42	—	86	120	6.8	532
147	40	6	80;120	—	—	20	—	—	—	—	534
206	105	6	160;190	2	6/82	50	—	—	—	—	535
167	28	6	80;120;155	—	—	15	—	34	65	6.3	536
300	25	6	140;160	17	6/82	3	.01	34	110	7.2	537
100	50	6	60	19	6/82	20	—	34	65	6.7	538
221	60	6	102;221	—	—	3	—	51	100	6.9	539

Table 40.

Well location		Owner	Driller	Year com-pleted	Use	Alti-tude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Number	Lat–Long							
De–540	395050–753239	Lannette Badel	Miller Pump Service, Inc.	1978	H	395	F	wb/sch
541	395038–753233	C. Markland	Kenneth L. Madron	1981	H	390	F	wb/sch
542	395040–753235	R. Skull	do.	1982	H	375	S	wb/sch
543	395158–753023	Concord School	Thomas G. Keyes	1978	T	340	F	wb/sch
544	395205–753008	Garnet Valley High School	do.	1962	T	315	F	wb/sch
545	395157–753021	Concord School	—	—	U	325	F	wb/sch
546	395215–753044	Paul Hist	Brown Brothers Drilling, Inc.	1975	H	390	H	wb/sch
547	395220–753120	S. Schepanski	Thomas G. Keyes	1979	H	280	S	wb/sch
548	395128–753048	Nina Krautzel	Brookover Well Drilling Co.	1979	H	385	F	wb/sch
550	395130–753053	R. Riegel	Kenneth L. Madron	1980	H	385	F	wb/sch
551	395138–753003	J. Discola	Thomas G. Keyes	1977	H	265	W	wmg/gn
552	395133–753014	A. Skinner	do.	1978	H	350	W	wmg/gn
553	395056–753010	Colonial Pipeline Co.	do.	1979	N	425	F	wmg/gn
554	395053–753128	A. Stang	do.	1981	H	420	F	wmg/gn
555	395107–753129	J. Wily	Brookover Well Drilling Co.	1978	H	405	F	wb/sch
556	395014–753055	C. Kulp	Thomas G. Keyes	1981	H	405	F	wmg/gn
557	395011–752949	K. Healy	do.	1980	H	390	S	wmg/gn
558	395023–752941	E. Blome	F. L. Bollinger and Sons	1977	H	390	S	wmg/gn
559	395023–752942	H. Davitt	do.	1977	H	390	S	wmg/gn
560	395017–752903	James McKay	Thomas G. Keyes	1978	H	330	S	wmg/gn
561	395044–752856	Thomas Bohner	Brookover Well Drilling Co.	1971	H	320	S	wmg/gn
562	395122–752933	Michael Karnis	Kenneth L. Madron	1981	H	370	W	wmg/gn
563	395119–752923	Gary Beson	Thomas G. Keyes	1981	H	385	F	wmg/gn
564	395120–752926	Mary Krug	do.	1979	H	380	F	wmg/gn
565	395118–752924	J. Passino	do.	1979	H	380	F	wmg/gn
566	395209–752910	A. Sparks	Brookover Well Drilling Co.	1978	H	290	S	wb/sch
567	395148–752910	Richard Lloyd	do.	1977	H	250	W	wb/sch
568	395109–752720	J. Summers	Thomas G. Keyes	1979	H	190	S	wmg/gn
569	395111–752718	do.	do.	1979	H	190	S	wmg/gn
570	395108–752722	D. Chattin	do.	1979	H	180	S	wmg/gn
571	395111–752728	C. Jenkins	do.	1977	H	150	S	wmg/gn
572	394943–752633	J. Schmidt	do.	1979	H	100	F	wan/gn
573	395213–753535	Brandywine Museum	do.	1969	C	170	V	Ybfa/gn
574	395145–793234	—	Edward Powell Well Drilling	1982	—	360	H	wb/sch
575	395108–752744	Master Food Distr.	C. S. Garber and Sons, Inc.	1979	H	150	S	wmg/gn
576	394957–752754	N. Luzak	Thomas G. Keyes	1977	H	190	S	wan/gn
577	395213–753226	Christine Prati	Kenneth L. Madron	1978	H	400	H	wb/sch
578	395210–753228	J. Shaw	do.	1978	H	385	—	wb/sch
579	395211–753227	B. Delguidice	do.	1978	H	405	H	wb/sch
580	395012–752712	G. Fry	Thomas G. Keyes	1978	H	115	F	wan/gn
581	395011–752715	John Rohrer	C. S. Garber and Sons, Inc.	1980	H	110	F	wan/gn
582	395111–752954	J. Carpenter	Brown Brothers Drilling, Inc.	1979	H	145	F	wmg/gn
583	395112–752959	E. Cross	Kenneth L. Madron	1981	H	405	F	wmg/gn
584	395059–752801	M. Evaneszak	do.	1981	H	220	S	wmg/gn

(Continued)

Total depth below land surface (feet)	Casing Depth (feet)	Casing Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level Depth below land surface (feet)	Static water level Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity [(gal/min)/ft]	Hard-ness (mg/L)	Specific conduc-tance (µmho/cm at 25°C)	pH (units)	Well number
195	94	6	180;190	30	4/78	45	—	68	150	7.3	De–540
146	44	6	110;140	9	6/82	15	—	51	140	5.9	541
106	42	6	60;90	35	1/82	20	—	—	—	—	542
170	72	6	78;98;152	26	6/78	60	.43	51	150	6.4	543
200	—	—	—	—	—	—	—	100	240	6.4	544
—	—	—	—	26	6/82	—	—	—	—	—	545
102	40	6	57;83	30	6/82	10	.50	120	280	6.3	546
300	40	6	282	20	9/79	2	.01	51	190	8.0	547
43	39	6	40	8	7/79	30	1.4	34	90	5.8	548
146	40	6	100;140	19	6/82	10	—	17	55	5.9	550
148	105	6	117;135;148	15	6/77	12	.10	—	—	—	551
140	48	6	45;62;91	15	9/78	3	.03	—	—	—	552
304	20	6	23	12	6/82	2	.01	34	75	6.4	553
135	87	6	90	17	6/82	5	.05	51	80	7.4	554
83	71	6	46;67;74	29	8/78	50	1.6	—	—	—	555
298	40	6	34;214;281	30	9/81	2	.01	—	—	—	556
250	52	6	65;146	9	6/82	2	.01	120	480	—	557
300	66	6	260	30	6/82	6	—	150	500	6.1	558
300	65	6	160	—	—	3	—	—	—	—	559
260	60	6	195;238	46	6/82	2	.01	100	220	7.1	560
107	16	6	54;68	24	4/71	2	.02	51	170	6.6	561
156	53	6	100;135	—	—	4	—	68	150	7.2	562
240	24	6	33;220	31	6/82	6	.03	17	60	6.4	563
120	25	6	30	19	6/82	8	.08	34	100	5.8	564
100	50	6	65	15	10/79	10	.13	34	80	6.1	565
83	46	6	61	26	6/82	7	.22	86	220	6.1	566
83	30	6	66;74	27	3/77	6	.36	68	170	6.9	567
260	67	6	49;68;120	35	2/79	2	.01	—	—	—	568
100	60	6	60;70;90	24	6/82	10	.14	51	130	5.8	569
240	85	6	82;230	25	2/79	2	.01	—	—	—	570
120	65	6	71;79;98;120	40	1/77	15	.21	—	—	—	571
280	31	6	190	7	6/82	2	.01	170	450	6.3	572
86	70	6	18;32;46	12	8/69	—	—	220	490	6.8	573
60	38	8	—	6	6/82	—	—	—	—	—	574
100	53	6	60;68;74	20	6/82	20	.24	190	480	6.5	575
78	30	6	37;78	8	8/77	35	.50	—	—	—	576
152	32	6	90;135	64	6/82	6	—	86	190	6.5	577
129	34	6	52;95	—	—	12	—	—	—	—	578
104	40	6	52;80	40	8/78	20	—	—	—	—	579
200	20	6	95;185	20	6/82	6	.04	68	160	6.5	580
180	21	6	87;153	27	6/82	15	.12	68	280	7.6	581
63	32	6	43;56	20	10/79	30	6.0	—	—	—	582
85	40	6	50;79	10	6/82	20	—	17	65	6.5	583
236	30	6	—	40	6/82	1	.004	68	140	6.2	584

Table 40.

Well location		Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Number	Lat–Long							
De–585	395144–752831	Dan Malecky	—	1975	H	260	W	wb/sch
586	395225–752915	P. Dargay	Kenneth L. Madron	1980	H	310	H	wb/sch
587	395118–752925	Knoll Clayton	Thomas G. Keyes	1979	H	380	F	wmg/gn
588	395119–752927	Robert Ryan, Inc.	do.	1981	H	385	F	wmg/gn
589	395045–753229	Hunter Construction Co.	Miller Pump Service, Inc.	1977	H	395	F	wb/sch
590	395101–753329	Daniel Bell	Calvin E. Powell	—	H	360	S	wb/sch
591	395115–753018	C. Fouraker	Brown Brothers Drilling, Inc.	1979	H	385	W	wmg/gn
592	395119–753422	K. Dukes	Kenneth L. Madron	1980	H	380	H	wb/sch
593	395137–753214	Foggia	Edward Powell Well Drilling	1982	H	380	H	wb/sch
594	395130–753157	P. Baziotes	Thomas G. Keyes	1978	H	380	H	wb/sch
595	395104–753314	Barrie Hesp	Charles Lauman and Sons	1978	H	310	S	wb/sch
596	395311–752856	T. Yocum	Thomas G. Keyes	1978	H	220	V	Ybfa/gn
597	395319–752839	T. Dambro	Kenneth L. Madron	1981	H	275	F	Ybfa/gn
598	395258–752721	B. Wojewojka	Thomas G. Keyes	1978	H	290	F	wb/sch
599	395318–752707	G. Rendell	do.	1979	H	230	S	wb/sch
600	395228–752701	J. Augsberger	do.	1977	H	240	S	wmg/gn
601	395228–752659	C. Pelkington	do.	1977	H	235	S	wmg/gn
602	395229–752659	P. Scull	do.	1977	H	225	S	wmg/gn
603	395231–752703	Ugo Fida	do.	1982	H	190	S	wmg/gn
604	395234–752659	B. Holmes	do.	1977	H	165	S	wmg/gn
605	395233–752656	F. Dzcobzzyns	do.	1977	H	190	S	wmg/gn
606	395242–752650	A. Sullivan	do.	1977	H	160	S	wmg/gn
607	395303–752642	J. Faulkner	do.	1982	H	170	S	wma/gn
608	395327–752632	A. Smith	do.	1981	H	120	S	wma/gn
609	395318–752612	J. Elser	do.	1977	H	305	H	wma/gn
610	395316–752611	A. Irons	do.	1979	H	310	H	wma/gn
611	395256–752545	R and D Machine	do.	1977	H	60	V	wp/sch
612	395328–752624	Crozerville Church	do.	1981	H	150	S	wma/gn
613	395330–752631	J. Steward	do.	1981	H	110	S	wma/gn
614	395829–752717	Wood Beer Co.	do.	1979	C	365	S	Ybfa/gn
615	395828–752717	Henderson Construction Co.	do.	1980	C	360	S	Ybfa/gn
616	395825–752735	G. Zarelli	Brookover Well Drilling Co.	1980	N	320	S	Ybfa/gn
617	395824–752735	do.	do.	1978	N	310	S	Ybfa/gn
618	395825–752706	Pier-Angeli Co.	do.	1980	N	375	S	Ybfa/gn
619	395632–752804	Edgemont Township	Thomas G. Keyes	1976	H	440	F	Ybfg/gn
620	395718–752748	J. Lachman	Calvin E. Powell	1979	H	400	S	Ybfa/gn
621	395752–752823	S. Crowley	Brookover Well Drilling Co.	1980	H	295	S	Ybfg/gn
622	395744–752853	C. Lonsidel	Thomas G. Keyes	1979	H	230	F	Ybfa/gn
623	395717–752859	Edward George	do.	1981	H	310	S	Ybfa/gn
624	395453–752713	New Darlington lot 3	do.	1979	H	290	S	Ybfa/gn
625	395649–752856	Fred Wetsford	Kenneth L. Madron	1980	H	460	H	Ybfg/gn
626	395603–752922	J. Gentile	Thomas G. Keyes	1977	H	390	S	Ybfa/gn
627	395606–752930	MacDonald	do.	1977	H	440	S	Ybfg/gn
628	395614–752937	R. Williams	do.	1980	H	415	S	Ybfg/gn
629	395558–752915	E. Greim	do.	1977	H	370	S	Ybfa/gn

(Continued)

Total depth below land surface (feet)	Casing Depth (feet)	Casing Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level Depth below land surface (feet)	Static water level Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity [(gal/min)/ft]	Hardness (mg/L)	Specific conductance (µmho/cm at 25°C)	pH (units)	Well number
260	—	—	—	20	11/75	1	.004	—	—	—	De–585
187	45	6	90;145;175	34	6/82	10	—	86	220	6.4	586
140	62	6	65;115	10	10/79	7	.06	—	—	—	587
320	52	6	258	30	5/81	1	—	—	—	—	588
221	120	6	210	40	3/79	15	—	—	—	—	589
—	—	—	—	37	6/82	—	—	34	75	5.9	590
104	40	6	80;101	40	12/79	15	1.5	—	—	—	591
170	45	6	90;150	—	—	8	—	—	—	—	592
346	43	6	54;73;205; 336	31	6/82	15	.13	—	—	—	593
140	40	6	44	11	6/82	6	.06	120	260	6.2	594
175	34	6	58;132	52	6/82	7	—	51	130	6.4	595
242	40	6	54;215	17	6/82	3	.02	—	—	—	596
226	42	6	80;200	—	—	5	—	—	—	—	597
95	51	6	59;89	34	6/82	45	.90	120	320	6.6	598
120	60	6	108	19	6/82	15	.25	140	310	6.5	599
237	35	6	87;126;208; 237	40	9/77	3	.02	—	—	—	600
177	66	6	99;166;177	22	6/82	1	.01	240	600	6.0	601
137	82	6	87;113;137	35	9/77	10	.11	—	—	—	602
322	75	6	173;322	27	6/82	.5	.002	150	380	6.4	603
98	72	6	79;89;98	14	8/77	20	.27	—	—	—	604
77	64	6	69;77	9	6/82	20	.38	—	—	—	605
50	40	6	42;50	5	6/82	20	.63	100	220	6.7	606
120	25	6	45	40	11/78	2	.03	86	380	6.5	607
100	40	6	57	42	3/81	12	.23	—	—	—	608
361	40	6	283;312;361	180	12/77	1	.01	—	—	—	609
160	20	6	130	50	7/79	12	.11	—	—	—	610
156	41	6	83;122;156	20	6/82	4	.03	150	360	7.0	611
158	36	6	45;110	27	6/82	5	.04	120	330	6.1	612
80	40	6	52	31	6/82	10	.25	140	500	5.5	613
100	40	6	75	10	1/79	28	.33	51	160	6.2	614
250	35	6	65;235	25	6/82	8	.03	360	180	6.6	615
103	30	6	61;94	15	1/80	12	.18	86	190	6.5	616
232	37	6	70;165;203	56	9/78	6	.04	86	210	6.8	617
104	42	6	73;84;88	55	6/82	12	.35	86	200	6.4	618
101	31	6	42;79;90	31	6/82	50	.86	—	—	—	619
160	53	6	98;119;132; 157	23	6/82	15	.13	51	120	6.5	620
50	34	6	49	34	7/82	15	1.9	100	240	6.2	621
149	40	6	18;136	12	6/82	100	.81	86	280	7.3	622
140	40	6	57;70;98;135	36	7/82	6	.06	68	200	6.5	623
160	78	6	84;110	55	8/79	6	.06	—	—	—	624
106	85	6	95	9	7/82	8	—	51	120	6.9	625
245	40	6	44;235;245	23	4/77	50	.24	—	—	—	626
223	55	6	91;104;206; 223	27	7/82	6	.03	86	190	6.9	627
80	23	6	28;52	10	5/80	10	.15	68	190	6.5	628
195	58	6	185;195	60	7/82	4	.03	100	240	7.3	629

Table 40.

Well location								
Number	Lat–Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
De–630	395651–752806	B. Stowell	Brookover Well Drilling Co.	1981	H	460	S	Ybfg/gn
631	395633–752925	Carmine Deprisco	Thomas G. Keyes	1973	H	450	S	Ybfg/gn
632	395623–752933	John Wenderoth	Brookover Well Drilling Co.	1976	H	415	S	Ybfg/gn
633	395631–752914	J. Carr	Thomas G. Keyes	1978	I	455	H	Ybfg/gn
634	395603–752834	Edgar Bullock	Brookover Well Drilling Co.	1973	H	430	H	Ybfg/gn
635	395426–752921	G. Claridge	Thomas G. Keyes	1979	H	220	V	Ybfa/gn
636	395903–752606	—	Charles Lauman and Sons	1976	H	410	S	Ybfa/gn
637	395911–752559	Edward Fahey	C. S. Garber and Sons, Inc.	1978	H	320	H	Ybfa/gn
638	395909–752601	Stanley Ciesielslu	do.	1977	H	330	H	Ybfa/gn
639	395912–752602	Dennis Nicholas	do.	1978	H	310	S	Ybfa/gn
640	395914–752605	Rogers	do.	1978	H	285	S	Ybfg/gn
641	395911–752606	John Driskill	do.	1977	H	270	S	Ybfg/gn
644	395738–752829	J. McCleary	Brookover Well Drilling Co.	1980	H	290	H	Ybfa/gn
675	395701–752527	William Toser	do.	1979	H	275	W	Ybfa/gn
676	395658–752535	N. Rubin	Thomas G. Keyes	1981	H	295	S	Ybfa/gn
677	395713–752546	Warren Evans	do.	1979	U	390	S	Ybfa/gn
678	395713–752546	do.	—	—	H	350	S	Ybfa/gn
679	395540–752544	P. Parker	Thomas G. Keyes	1981	H	335	S	wum/ser
680	395356–752645	Middletown Township Parks	do.	1978	H	305	S	Ybfa/gn
681	395401–752643	S. Ross	do.	1981	H	340	H	Ybfa/gn
682	395406–752625	R. Bullman	do.	1977	H	315	S	wum/ser
683	395341–752657	James Gane	do.	1978	H	185	S	Ybfa/gn
684	395505–752618	Red Maple Nursery	do.	1980	I	370	H	wum/ser
685	395605–752257	L. Snyder	do.	1977	H	280	S	wp/sch
686	395528–752523	O. Armitage	do.	1981	H	345	S	wum/ser
687	395514–752738	H. Green	do.	1978	H	335	H	Ybfa/gn
688	395535–752725	B. Force	do.	1978	H	295	V	Ybfa/gn
689	395434–752734	E. Acton	Petersheim Bros.	1978	H	310	H	Ybfa/gn
690	395736–752354	D. Krumbhaar	Thomas G. Keyes	1981	E	230	S	wp/sch
691	395736–752354	do.	do.	1981	H	230	S	wp/sch
692	395759–752232	Frank Disantis	Barry Lee Myers	1979	H	320	S	wp/sch
693	395759–752248	D. Latta	Thomas G. Keyes	1973	H	305	W	wp/sch
694	395804–752356	Springton Lake Church	do.	1974	H	355	S	wum/ser
695	395743–752409	D. Marona	do.	1980	E	260	S	wp/sch
696	395743–752409	do.	—	—	H	260	S	wp/sch
697	395758–752527	Jeoffry Cudd	Thomas G. Keyes	1971	H	340	S	Ybfa/gn
698	395714–752527	Elmer Wells, Jr.	do.	1976	H	340	H	Ybfa/gn
699	395826–752454	J. Hoy	Brookover Well Drilling Co.	1978	H	430	H	Ybfa/gn
700	395801–752507	C. Green	Thomas G. Keyes	1980	E	260	W	Ybfa/gn
701	395801–752507	Kenneth Lutter	Kenneth L. Madron	—	E	260	W	Ybfa/gn
702	395801–752507	do.	do.	1980	H	265	W	Ybfa/gn
703	395343–752846	L. Paolella	do.	1980	E	325	S	Ybfa/gn
704	395344–752820	Seth Gardner	Petersheim Bros.	1975	E	295	H	Ybfa/gn
705	395344–752820	do.	Thomas G. Keyes	1980	E	295	H	Ybfa/gn

(Continued)

Total depth below land surface (feet)	Casing: Depth (feet)	Casing: Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level: Depth below land surface (feet)	Static water level: Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity [(gal/min)/ft]	Hard-ness (mg/L)	Specific conduc-tance (µmho/cm at 25°C)	pH (units)	Well number
224	21	6	70;94	16	7/82	3	.02	68	160	6.3	De–630
162	45	6	50;100	70	9/73	4	.04	170	460	6.7	631
123	30	6	78;114	19	7/82	12	.12	34	60	6.7	632
80	25	6	45;72;80	8	7/82	25	.39	32	65	6.2	633
144	16	7	113	53	6/73	2	.03	—	—	—	634
100	31	6	65;90	15	7/82	15	.19	68	140	6.8	635
357	60	6	109	50	4/76	1	—	86	230	6.4	636
122	62	6	70;110	21	7/82	15	.15	51	130	6.9	637
98	46	6	48;70;85	37	3/77	30	.49	—	—	—	638
160	64	6	80;115;150	21	7/82	12	.17	51	130	6.9	639
120	46	6	60;75;110	23	7/82	10	.12	140	320	6.7	640
110	82	6	85;100	21	7/82	20	.24	120	280	6.5	641
143	30	6	120	34	7/82	8	.10	86	230	6.4	644
85	40	6	27;74	4	7/83	10	.25	140	360	6.2	675
380	20	6	135;356	128	7/82	8	.03	170	450	7.2	676
300	26	6	120	76	2/83	2	.01	—	—	—	677
100	—	—	—	—	—	—	—	430	1,500	6.9	678
80	51	6	65	17	6/81	35	.60	—	—	—	679
200	30	6	57;78;111; 152	29	2/83	12	.08	140	260	6 7	680
100	20	6	12;40	40	3/81	50	.91	—	—	—	681
340	79	6	172;332;340	9	7/82	2	.01	120	260	7.6	682
220	80	6	205	39	7/82	3	.02	120	280	7.5	683
200	60	6	67;80;100; 115	11	7/82	60	.36	68	150	7.6	684
117	43	6	67;87;96;117	52	7/82	7	.17	86	240	6.5	685
110	90	6	94	24	7/82	15	.23	—	—	—	686
222	—	6	89;138;199; 209	77	7/82	10	.06	120	280	7.0	687
220	62	6	—	30	7/82	70	.41	86	190	7.3	688
408	40	6	55	50	11/78	1	.20	—	—	—	689
203	60	6	67;83;129	40	4/81	23	.14	—	—	—	690
203	60	6	67;83;130	40	4/81	22	.14	—	—	—	691
145	20	6	70;90	25	7/82	12	—	100	230	6.1	692
125	47	6	32;58;80;113	19	7/82	10	.13	100	300	6.4	693
80	60	6	70	30	7/83	18	.53	140	270	6.1	694
140	72	6	73;90;110; 127	35	11/80	20	.20	—	—	—	695
—	—	—	—	—	—	—	—	34	100	5.7	696
60	40	6	44	24	7/71	15	.43	—	—	—	697
148	—	6	135	65	7/82	20	.22	100	250	7.0	698
294	18	6	187	68	10/78	.5	.002	—	—	—	699
80	49	6	51;67	12	7/82	15	.25	—	—	—	700
100	—	—	—	14	7/82	—	—	—	—	—	701
87	40	6	60;75	20	7/82	10	—	68	190	6.6	702
186	58	6	80;140;170	44	8/82	35	—	—	260	7.1	703
130	51	6	55;68;100	30	1/75	25	1.00	68	210	6.0	704
80	44	6	52;66	20	9/80	20	.36	—	—	—	705

Table 40.

Well location: Number	Well location: Lat–Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
De–706	395343–752743	Richard Wood	Petersheim Bros.	1967	H	265	H	Ybfa/gn
707	395403–752732	Southeastern Pennsylvania Transportation Authority	Thomas G. Keyes	1982	H	145	V	Ybfa/gn
708	395309–752659	Patrick Charles	Brookover Well Drilling Co.	1968	H	190	S	wum(?)/ ser
709	395324–752653	George Ormsby	Thomas G. Keyes	1968	H	270	S	Ybfa/gn
710	395319–752635	D. Gabelle	do.	1981	H	130	S	wma/gn
711	395348–752119	Strath Haven Condominiums	do.	1973	U	80	S	pma/gn
712	395442–751947	Essie Jackson	do.	1975	U	145	W	gr/gn
713	395544–751722	Ace Metal, Inc.	do.	1976	N	130	F	wp/sch
714	395601–751743	Mary Gabay	do.	1967	H	95	V	wp/sch
715	395632–751735	Alex Dumbrosky	do.	1976	U	230	H	wp/sch
716	395650–752213	Robert Hampton	do.	1970	H	255	S	wp/sch
717	395653–752209	John MacDonald	—	—	H	260	S	wp/sch
718	395645–752154	E. Casey	Thomas G. Keyes	1977	H	260	W	wp/sch
719	395818–752229	Rose Tree Swim Club	do.	1981	R	265	W	wum/ser
720	395842–752302	A. Klava	Petersheim Bros.	1981	H	465	F	wum/ser
721	395523–753002	Glen Mills Schools	Thomas G. Keyes	1981	T	250	V	Ybfa/gn
722	395503–752946	do.	do.	1981	T	325	S	Ybfa/gn
723	395512–752937	do.	—	—	—	280	S	Ybfa/gn
724	395504–752927	do.	Thomas G. Keyes	1979	H	300	S	Ybfa/gn
725	395907–752449	Clark Wright	do.	1977	H	370	W	Ybfa/gn
726	395708–752310	James Mackey	Brookover Well Drilling Co.	1966	H	210	S	wp/sch
727	395712–752248	Niemeyer Corp.	Thomas G. Keyes	1982	I	230	W	wp/sch
728	395753–752435	J. Carson	do.	1982	H	280	S	Ybfa/gn
729	395804–752519	Gilroy Roberts	Calvin E. Powell	1980	H	400	H	Ybfa/gn
730	395804–752519	do.	—	—	U	400	H	Ybfa/gn
731	395805–752516	T. Moser	Brookover Well Drilling Co.	1982	H	390	S	Ybfa/gn
732	395805–752516	do.	do.	1982	H	390	S	Ybfa/gn
733	395407–753146	J. Lees	Thomas G. Keyes	1978	H	420	S	Ybfa/gn
734	395415–753152	K. Robson	do.	1981	H	455	H	Ybfa/gn
735	395436–753208	Paul Gilmore	Kenneth L. Madron	1979	H	460	S	Ybfa/gn
736	395432–753217	Lillian Carbone	do.	1979	H	465	S	Ybfa/gn
737	395433–753208	S. Jamgochian	Brookover Well Drilling Co.	1982	H	465	S	Ybfa/gn
738	395402–753131	Greenetown Corp.	Thomas G. Keyes	1981	H	365	S	Ybfa/gn
739	395401–753134	do.	do.	1981	H	380	S	Ybfa/gn
741	395347–753038	William Baker	Bonnie J. Myers	1978	H	380	H	Ybfa/gn
742	395346–753030	N. Manos	Thomas G. Keyes	1979	H	360	S	Ybfa/gn
743	395345–753028	George Kane	Brookover Well Drilling Co.	1976	H	340	S	Ybfa/gn
744	395332–753041	D. Decola	do.	1978	H	375	S	Ybfa/gn
745	395345–753033	Frank Miller	do.	1975	H	380	S	Ybfa/gn
746	395341–753036	David Herd	do.	1977	H	400	H	Ybfa/gn
747	395303–753108	Georskey	Thomas G. Keyes	1981	H	400	S	Ybfa/gn
748	395303–753107	Philip Kline	do.	1981	H	365	S	Ybfa/gn
749	395628–753025	L. De George	do.	1977	H	415	S	Ybfa/gn
750	395625–753020	Bobbi Lee	Barry Lee Myers	1981	H	430	S	Ybfa/gn
751	395646–753048	G. Berger	Thomas G. Keyes	1981	H	310	W	Ybfa/gn

(Continued)

Total depth below land surface (feet)	Casing Depth (feet)	Casing Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level Depth below land surface (feet)	Static water level Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity [(gal/min)/ft]	Hard-ness (mg/L)	Specific conduc-tance (µmho/cm at 25°C)	pH (units)	Well number
310	41	6	58;68;210	40	9/67	9	—	—	—	—	De–706
129	41	6	48;68;88;108	20	8/82	50	.48	100	330	6.8	707
117	90	6	108	40	9/68	2	.03	—	—	—	708
86	61	5	64;77	—	—	10	—	68	180	5.4	709
202	40	6	108	20	8/81	2	.01	—	—	—	710
290	17	8	35;85;155; 290	9	8/82	67	.39	—	—	—	711
225	40	6	48;63;220	12	1/75	2	.01	—	—	—	712
200	26	6	33;100;126; 184	15	3/76	20	.11	17	480	6.0	713
150	22	6	133	23	3/67	15	.12	—	—	—	714
180	28	6	52;115	30	11/76	2	.02	—	—	—	715
257	43	6	108	50	7/70	6	.03	—	—	—	716
—	—	—	48;83	—	—	—	—	103	300	6.1	717
221	28	6	136;147;221	—	—	2	—	—	—	—	718
244	43	6	49;94;124; 170	5	4/81	50	.21	—	—	—	719
220	63	6	75;205	30	3/81	22	.13	100	210	7.5	720
400	108	8	184;223	38	9/82	8	.02	—	—	—	721
358	48	6	188;278	16	6/81	7	.02	170	380	7.8	722
300	20	6	—	—	—	—	—	140	260	6.4	723
260	20	6	—	39	9/82	2	.01	86	230	7.0	724
161	81	6	106;148;161	20	1/83	20	.22	86	180	7.5	725
228	70	6	80;142;192; 223	60	9/66	20	.16	—	—	—	726
403	30	6	50;60;100	24	1/83	10	—	51	160	6.3	727
283	40	6	248	34	1/83	7	—	51	150	7.0	728
500	—	—	—	250	1/83	—	—	86	240	7.9	729
300	—	—	—	141	1/83	—	—	—	—	—	730
63	44	6	54	44	5/82	10	1.7	—	—	—	731
84	44	6	72	44	5/82	12	.46	—	—	—	732
150	40	6	85;130	50	8/78	8	.08	—	—	—	733
160	40	6	130	60	6/81	20	.21	—	—	—	734
126	45	6	79;115	32	1/82	12	—	86	200	6.6	735
126	44	6	70;90;110	—	—	20	—	—	—	—	736
125	61	6	71;117	48	5/82	12	.38	—	—	—	737
120	50	6	57	7	1/83	60	.60	—	—	—	738
142	49	6	48;71;90;121	13	1/83	10	.08	—	—	—	739
200	60	6	150;170	—	—	5	—	—	—	—	741
105	25	6	65	30	1/83	15	.20	68	200	6.3	742
83	23	6	56;74	31	5/76	5	.13	86	200	6.2	743
83	48	6	76	38	4/78	6	.16	—	—	—	744
63	21	6	41;58	42	1/83	5	.21	—	—	—	745
103	20	6	67;94	26	3/77	6	.09	—	—	—	746
260	34	6	49;174	25	1/83	4	.02	51	140	6.2	747
340	40	6	297	42	1/83	3	.01	68	140	5.8	748
117	40	6	61;102;117	20	6/77	12	.14	—	—	—	749
100	28	6	45;65	29	1/83	8	—	—	—	—	750
78	37	6	35;51;56	16	1/83	50	.86	—	—	—	751

Table 40.

Well location Number	Lat–Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
De–752	395640–753029	E. Williams	Brookover Well Drilling Co.	1981	H	380	S	Ybfa/gn
753	395640–753036	J. Lentz	Thomas G. Keyes	1980	H	375	S	Ybfa/gn
754	395639–753038	Kenneth Balsley	do.	1976	H	375	S	Ybfa/gn
755	395251–753332	R. Gartner	Kenneth L. Madron	1979	H	380	S	Ybma/gn
756	395257–753337	J. Yocoe	Calvin E. Powell	1981	H	410	S	Ybma/gn
757	395254–753336	Joseph McGannel	Kenneth L. Madron	1981	H	400	S	Ybma/gn
758	395251–753335	David Mitchell	do.	1979	H	395	S	Ybma/gn
759	395253–753338	do.	do.	1979	H	410	S	Ybma/gn
760	395255–753340	do.	do.	1979	H	430	S	Ybma/gn
761	395044–752247	Ches-Penn Health Services	Thomas G. Keyes	1982	H	55	V	wp/sch
762	395044–752247	do.	do.	1982	H	55	V	wp/sch
763	395125–752224	Crozier-Chester Medical Center	do.	1981	I	55	S	wp/sch
764	395029–752520	William Derrickson	do.	1973	H	115	F	wmg/gn
765	395455–753239	Wilson Chu	C. S. Garber and Sons, Inc.	1983	H	410	S	Ybfa/gn
766	395321–752634	J. Brennon	Thomas G. Keyes	1977	H	125	S	wma/gn
767	395306–752616	C. Murray	do.	1977	H	275	S	wma/gn
768	395336–752540	Keith White	do.	1976	H	210	S	wp/sch
769	395327–752452	W. Diamond	do.	1979	H	130	S	wp/sch
770	395433–752432	R. Skoog	do.	1981	H	285	S	wp/sch
771	395614–752755	C. Gentile	do.	1977	H	380	W	Ybfa/gn
772	400001–752618	J. Saunders	do.	1982	H	435	H	Ybfg/gn
773	395538–752909	Renaissance Homes, Ltd.	Barry Lee Myers	1981	H	360	H	Ybfa/gn
774	395457–752924	R. Marland	Edward Powell Well Drilling	1981	H	330	S	Ybfa/gn
775	395454–752915	Peter Morris	Brookover Well Drilling Co.	1970	H	330	S	Ybfa/gn
776	395449–752916	J. Koziliowski	Edward Powell Well Drilling	1981	H	335	S	Ybfa/gn
777	395426–752909	Donald Kasper	Brookover Well Drilling Co.	1966	H	180	S	Ybfa/gn
778	395216–753532	W. Waller	Thomas G. Keyes	1979	H	170	V	Ybfa/gn
779	395432–753250	Taylor	Edward Powell Well Drilling	1982	H	425	F	Ybfa/gn
780	395431–753246	James Zierdt	Kenneth L. Madron	1980	H	425	F	Ybfa/gn
781	395525–753033	David Young	Thomas G. Keyes	1967	H	400	S	Ybfa/gn
782	395451–753144	Robert Kirmes	do.	1971	H	460	F	Ybfa/gn
783	395445–753150	Baptist Child Services	do.	1980	T	460	F	Ybfa/gn
785	395359–753345	Nick's Fast Food	Kenneth L. Madron	1982	H	450	S	Ybfa/gn
786	395355–753405	R. Taylor	Thomas G. Keyes	1978	H	465	H	Ybfa/gn
787	395257–753441	A. Gross	do.	1977	H	380	W	Ybma/gn
788	395511–753214	M. Weidel	Edward Powell Well Drilling	1982	H	355	S	Ybfa/gn
789	395457–753227	William Hamilton	R. Walter Slauch and Sons	1983	H	400	S	Ybfa/gn
790	395458–753227	do.	do.	1983	—	385	S	Ybfa/gn
792	395323–753109	Joseph Dawson	Thomas G. Keyes	1978	U	335	S	Ybfa/gn
793	395323–753109	do.	do.	1978	U	335	S	Ybfa/gn
794	395323–753109	do.	do.	1978	H	335	S	Ybfa/gn
795	395326–753106	B. Force	do.	1979	H	275	V	Ybfa/gn
796	395327–753108	do.	do.	1979	H	265	V	Ybfa/gn
797	395326–753112	do.	do.	1979	H	290	S	Ybfa/gn

(Continued)

Total depth below land surface (feet)	Casing Depth (feet)	Casing Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level: Depth below land surface (feet)	Static water level: Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity [(gal/min)/ft]	Hard-ness (mg/L)	Specific conduc-tance (μmho/cm at 25°C)	pH (units)	Well number
165	28	6	71;90;150	34	1/83	4	.05	—	—	—	De–752
220	40	6	40;110	35	12/80	1	.01	—	—	—	753
170	60	6	51;133;159	30	6/76	6	.04	—	—	—	754
280	22	6	175;220	180	1/83	5	—	68	200	6.9	755
180	—	—	—	23	1/83	—	—	86	180	6.9	756
215	40	6	120;213	22	1/83	50	—	—	—	—	757
146	40	6	90;120;140	—	—	15	—	—	—	—	758
146	22	6	110;140	76	1/83	6	—	68	110	6.7	759
126	22	6	80;120	—	—	20	—	—	—	—	760
214	36	—	51;69;114; 199	—	—	150	—	—	—	—	761
202	38	6	112;135;165	—	—	65	—	—	—	—	762
359	20	6	25;48;118; 135;171;195	14	1/83	65	.19	200	470	5.7	763
175	30	6	30	17	1/83	2	.01	34	110	6.1	764
197	40	6	72;170;180	13	1/83	12	.10	—	—	—	765
79	26	6	28;79	10	11/77	20	.34	—	—	—	766
120	50	6	67;87;120	34	1/83	6	.09	68	160	7.0	767
140	30	6	55;140	42	4/76	5	.05	—	—	—	768
112	60	6	68	39	1/83	12	.21	220	600	6.4	769
230	56	6	50;110;218	57	3/81	10	.06	—	—	—	770
98	60	6	67;82;98	9	1/83	15	.19	—	—	—	771
203	60	6	68;70;175	45	1/83	20	—	51	140	6.7	772
300	25	6	70	—	—	2	—	—	—	—	773
210	20	6	130;190	45	11/81	12	.70	—	—	—	774
150	23	6	33;81	33	11/70	1	.01	—	—	—	775
208	40	6	147;187	40	9/81	4	.04	—	—	—	776
95	41	6	72;88	19	11/66	10	.21	—	—	—	777
98	80	6	84	8	1/83	17	.20	240	540	7.5	778
120	70	6	30;60;87;103	18	2/83	100	14	—	—	—	779
126	22	6	50;110	33	2/83	50	—	—	—	—	780
73	47	5	51;73	30	12/67	30	.70	—	—	—	781
200	60	6	98;146;195	49	9/71	10	.07	—	—	—	782
140	55	6	63;83;104	28	2/83	20	.19	34	130	7.1	783
126	42	6	70;110	30	1/82	20	—	—	—	—	785
200	24	6	40;137;194	35	10/78	2	.01	—	—	—	786
220	50	6	60;197;220	86	12/77	12	.10	—	—	—	787
120	33	6	60;68;97	25	9/82	40	1.1	—	—	—	788
128	31	6	36;100;128	10	2/83	18	.28	—	—	—	789
—	—	—	—	1	2/83	—	—	—	—	—	790
400	36	6	—	—	—	—	—	—	—	—	792
220	14	6	—	—	—	0	—	—	—	—	793
290	45	6	85;277	31	1/83	3	.01	—	—	—	794
80	54	6	60	6	10/79	18	.26	—	—	—	795
80	40	6	45;50	30	5/79	18	.40	—	—	—	796
160	25	6	50;62;125	25	4/79	5	.04	—	—	—	797

Table 40.

Well location: Number	Well location: Lat–Long	Owner	Driller	Year com- pleted	Use	Alti- tude of land surface (feet)	Topo- graphic setting	Aquifer/ lithology
De–798	395322–753114	R. Turnball	Thomas G. Keyes	1978	H	345	S	Ybfa/gn
799	395503–752946	Glen Mills Schools	Calvin E. Powell	1983	T	340	S	Ybfa/gn
800	395121–752025	Petrolite Corp.	—	—	U	15	V	wp/sch
801	395122–752026	do.	Thomas G. Keyes	1969	U	15	V	wp/sch
802	400244–752403	Samuel Hamilton	Thomas G. Keyes	1981	I	445	S	Ybmg/gn
803	400310–752128	Paul Wingate	Petersheim Bros.	1980	U	300	S	wb/sch
804	400301–752110	C. Hale	Thomas G. Keyes	1980	H	360	S	Ybfg/gn
805	400303–752105	Alfred Johnston	do.	1968	H	290	S	Ybfg/gn
806	400310–752130	Stephen Thal	do.	1977	H	300	S	wb/sch
807	400253–752213	Jeffrey White	do.	1977	H	395	S	Ybfg/gn
808	400253–752106	Rebecca Cregar	Ridpath and Potter Co.	1951	H	415	S	Ybfg/gn
809	400254–752105	Daniel Kelly	—	1976	H	400	S	Ybfg/gn
810	400127–752153	Radnor Valley Country Club	Thomas G. Keyes	1971	U	285	V	Ybma/gn
811	400110–752158	do.	do.	1971	U	340	W	Ybfg/gn
812	400113–752139	do.	do.	1971	U	285	V	Ybfg/gn
813	400057–752147	do.	do.	1971	U	370	S	Ybfg/gn
814	400049–752144	T. Drake	do.	1978	H	310	W	Ybfg/gn
815	400051–752050	Mary Luz Coady	do.	1980	C	350	S	Ybfg/gn
816	400008–752043	A. Amenta	do.	1979	H	285	W	wp/sch
817	400007–752037	H. Seegul	do.	1981	H	350	H	wp/sch
818	400010–752204	Leonard Goldstein	do.	1975	H	220	V	Ybfg/gn
819	400018–752200	Gary Construction	do.	1975	H	310	S	Ybfg/gn
820	395955–752052	H. Chadwick	do.	1969	H	230	S	wp/sch
821	395303–751715	Sharp and Dohme, Inc.	Ranney Collector Corp.	—	U	10	V	Qt/sg
822	395302–751700	do.	do.	—	U	10	V	Qt/sg
823	395308–751645	do.	do.	—	U	10	V	Qt/sg
824	395314–751630	do.	do.	—	U	15	V	Qt/sg
825	395318–751623	do.	do.	—	U	5	V	Qt/sg
826	395305–751631	do.	do.	—	U	5	V	Qt/sg
827	395153–751656	Westinghouse Electric Corp.	—	—	U	10	V	Qt/sg
828	395148–751654	do.	—	—	U	5	V	Qt/sg
829	395148–751659	do.	—	—	U	5	V	Qt/sg
830	395355–751528	Atlas Environ. Co., Inc.	Thomas G. Keyes	1971	F	15	V	wp/sch
831	395443–751722	Advance Transit Mix	do.	1981	H	90	W	wp/sch
832	395442–751723	do.	do.	1981	N	90	W	wp/sch
833	395552–751624	Lansdowne Racquetball Club	do.	1980	U	35	V	wp/sch
834	395408–751554	Coyle Realty Co.	do.	1975	U	25	V	wp/sch
835	395613–751636	Wildman Arms Apartments	—	1966	R	115	S	wp/sch
836	395615–751628	do.	—	1982	P	115	S	wp/sch
837	395618–751613	Barksdale Studios	Ridpath and Potter Co.	1952	C	115	F	wp/sch
838	395623–751543	Lansdowne Ice and Coal Co.	do.	1925	U	110	F	wp/sch
839	395720–752542	Emil Lintzmeyer	Calvin E. Powell	1961	H	350	W	Ybfa/gn
840	395711–752544	Samuel Shay	—	1961	H	315	S	Ybfa/gn
841	395716–752545	M. Cashman	Calvin E. Powell	1960	U	350	W	Ybfa/gn
842	395716–752544	do.	do.	1982	H	365	S	Ybfa/gn

(Continued)

Total depth below land surface (feet)	Casing: Depth (feet)	Casing: Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level: Depth below land surface (feet)	Static water level: Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity [(gal/min)/ft]	Hardness (mg/L)	Specific conductance (µmho/cm at 25°C)	pH (units)	Well number
160	27	6	73;139	40	10/78	21	.18	—	—	—	De–798
75	21	6	—	16	4/83	25	—	—	—	—	799
194	—	6	—	8	1/83	—	—	—	—	—	800
296	46	6	78;110	20	8/69	75	.27	—	—	—	801
200	47	6	80;100;120; 160	28	1/83	150	.91	86	190	6.0	802
90	40	6	58;80	43	2/83	20	—	86	280	5.4	803
200	33	6	50;140	60	9/80	8	.06	—	—	—	804
79	24	5	31;52;71	7	8/68	30	.45	—	—	—	805
90	32	6	70;90	—	—	15	—	—	—	—	806
137	52	6	83;109;129; 132;137	50	6/77	40	.52	170	330	6.5	807
145	6	6	—	—	—	—	—	68	170	5.8	808
—	—	6	—	59	2/83	—	—	—	—	—	809
40	20	6	40	2	4/83	20	.56	—	—	—	810
48	22	6	35	2	4/83	5	.21	—	—	—	811
50	18	6	25;30;40	3	4/83	3	.08	—	—	—	812
93	40	6	65;90	19	4/83	2	.02	—	—	—	813
160	20	6	69;119	41	6/78	8	.07	—	—	—	814
273	48	6	52;85;163; 182;208;242	29	4/83	20	.09	68	180	5.5	815
80	20	6	55	20	12/79	20	.36	—	—	—	816
198	60	6	110	70	5/81	1	.01	—	—	—	817
170	94	6	94;111;156	20	12/75	7	.05	—	—	—	818
120	38	6	105	36	11/75	15	.18	—	—	—	819
81	35	5	37;48;64	12	5/83	15	.28	—	—	—	820
10	—	—	—	—	—	—	—	—	—	—	821
20	—	—	—	—	—	—	—	—	—	—	822
23	—	—	—	—	—	8	1.3	—	—	—	823
24	—	—	—	—	—	—	—	—	—	—	824
19	—	—	—	—	—	15	1.4	—	—	—	825
31	—	—	—	—	—	22	2.6	—	—	—	826
—	—	—	—	3	4/83	—	—	—	—	—	827
—	—	—	—	.1	4/83	—	—	—	—	—	828
—	—	—	—	1	4/83	—	—	—	—	—	829
95	40	6	65;82	20	12/71	60	.81	—	2,200	5.8	830
600	49	6	300	13	5/83	4	.01	—	—	—	831
400	40	6	148;255;315; 365	10	5/81	10	.02	—	—	—	832
98	32	6	38;49	12	5/83	35	.48	—	—	—	833
400	40	6	190;275;350	2	5/83	38	.10	—	490	6.0	834
—	—	6	—	—	—	—	—	—	—	—	835
240	—	8	—	—	—	23	—	140	480	6.4	836
315	—	—	—	—	—	55	—	—	—	—	837
600	—	10	—	4	6/83	30	—	—	—	—	838
68	—	6	—	13	7/83	—	—	100	210	5.9	839
50	—	6	—	—	—	—	—	100	240	5.7	840
320	—	6	—	45	7/83	5	—	3,300	3,900	6.3	841
310	—	6	—	51	7/83	4	—	170	300	7.4	842

Table 40.

Well location								
Number	Lat–Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
De–843	395053–752907	Green School	—	1950	T	365	S	wmg/gn
844	395052–752911	A. Short	—	1950	H	380	S	wmg/gn
860	400059–752359	S. Calabro	Thomas G. Keyes	1983	U	305	S	Ybfg/gn
861	400058–752358	do.	do.	1983	H	270	V	Ybfg/gn
863	395929–752027	A. Nazari	Thomas G. Keyes	1977	H	220	W	wp/sch
864	395947–752122	M. Contino	do.	1982	H	185	V	wp/sch
865	395940–752123	A. Leffler	do.	1980	H	225	S	wp/sch
866	395812–752116	A. Buckley	do.	1981	H	325	S	wp/sch
867	395744–751956	K. Berry	do.	1980	H	175	S	wp/sch
868	395731–752015	Helen Missar	do.	1969	U	230	S	wp/sch
869	395627–752143	Muehlmatts Greenhouse	do.	1980	I	270	H	wp/sch
870	395618–751825	Upper Darby Township	do.	1976	H	130	V	wp/sch
871	395856–752011	Dennis McElhone	C. S. Garber and Sons, Inc.	1977	H	240	S	wp/sch
872	395858–752012	Ray Petolicchio	do.	1977	H	235	S	wp/sch
873	395858–752013	Community Builders	do.	1977	H	215	S	wp/sch
874	395859–752013	do.	do.	1977	H	205	S	wp/sch
875	395542–752100	Harlee Manor	Thomas G. Keyes	1979	T	270	W	wp/sch
876	395540–752059	do.	do.	—	T	260	W	wp/sch
877	395852–752005	Domanice Odorico	Brookover Well Drilling Co.	1967	H	225	S	wp/sch
878	395644–751925	Drexeline Plaza	Thomas G. Keyes	1981	C	160	V	gr/gn
879	395643–751924	do.	do.	1981	C	155	V	gr/gn
880	395642–751928	do.	do.	1981	C	145	V	gr/gn
881	395646–751918	Drexeline Apartments	do.	1967	R	175	S	wp/sch
882	395255–751951	Ridley Park Swim Club	do.	1978	R	60	V	wp/sch
883	395201–752803	Imperial Nurseries	do.	1983	I	297	F	wb/sch
884	395201–752803	do.	do.	1983	I	297	F	wb/sch
885	395039–752515	C and M Fun World	Edward Powell Well Drilling	1982	C	105	F	wmg/gn
886	395001–752805	Ogden Fire Co.	do.	1982	H	215	H	wan/gn
887	395138–753322	A. Verdon	do.	1982	H	340	W	wb/sch
888	395517–751812	Secane Swim Club	Petersheim Bros.	1967	R	140	V	wp/sch
889	400050–752010	Robert Horst	Thomas G. Keyes	1958	H	330	S	wp/gn
900	395500–752413	Elwyn Institute	—	—	U	120	V	wp/sch
901	395510–752934	Glen Mills Schools	Calvin E. Powell	—	T	200	S	Ybfa/gn

(Continued)

Total depth below land surface (feet)	Casing Depth (feet)	Casing Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level Depth below land surface (feet)	Static water level Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity [(gal/min)/ft]	Hardness (mg/L)	Specific conductance (μmho/cm at 25°C)	pH (units)	Well number
40	—	6	—	—	—	—	—	—	—	—	De–843
45	—	6	—	16	8/83	—	—	68	160	5.2	844
300	—	—	—	—	—	4	—	—	—	—	860
139	25	6	29;70;107	5	2/83	33	—	34	160	—	861
198	50	6	71;75;198	31	5/83	15	.10	—	—	—	863
170	53	6	57;146;152	—	—	10	—	—	—	—	864
100	25	6	40;65;90	25	11/80	20	.29	51	140	5.6	865
190	32	6	65;167	35	4/81	5	.03	—	—	—	866
140	45	6	110	15	5/83	20	.17	100	320	6.9	867
142	35	6	45;115;140	14	5/83	12	.13	—	—	—	868
120	20	6	37;96;102	20	5/83	30	.35	68	180	6.7	869
230	60	6	89;185;200	9	12/76	100	.52	—	—	—	870
297	67	6	278;285	61	11/77	45	.19	—	—	—	871
335	45	6	71;210;320	40	5/83	5	.05	100	260	—	872
260	33	6	66;126;140	17	12/77	4	.02	—	—	—	873
180	45	6	145	51	5/83	6	.13	120	340	6.8	874
283	9	6	15;24;65;103	11	5/83	12	.05	140	380	—	875
—	—	—	—	—	—	—	—	86	300	—	876
95	24	6	57;78	24	3/67	14	.38	86	210	—	877
110	73	6	73;85;100	11	5/83	7	.08	—	—	—	878
100	50	6	30;68;82	10	5/83	50	.63	—	—	—	879
110	40	6	84	7	5/83	11	.12	—	—	—	880
—	—	—	—	23	5/83	—	—	150	330	6.0	881
159	46	6	68;87;112; 143	6	5/83	20	.14	100	250	7.3	882
198	50	6	50;60;198	—	—	100	—	34	100	6.5	883
198	40	6	40;48;50;55	18	5/83	30	—	—	—	—	884
60	31	6	34;44;52	4	5/83	30	2.0	100	290	6.5	885
360	25	6	43;208;244; 320	16	5/83	6	.03	—	—	—	886
200	24	6	87;157;182; 195	1	5/83	—	—	51	160	6.8	887
150	32	6	60;75;110	8	4/67	38	—	—	—	—	888
80	40	6	—	40	12/83	7	—	100	260	5.7	889
675	—	—	—	4	1/84	65	.74	68	290	6.2	900
—	—	—	—	10	2/83	—	—	—	—	—	901

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Balmer, Wayne T.
Groundwater Resources of
Delaware County.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

GEOLOGIC MAP OF DELAWARE COUNTY, PENNSYLVANIA, SHOWING THE LOCATIONS OF SELECTED WELLS

HYDROGEOLOGY BY
WAYNE T. BALMER AND DREW K. DAVIS

1993

EXPLANATION

UNIT[1]	GEOLOGIC DESCRIPTION	WATER-BEARING PROPERTIES
TRENTON GRAVEL Qt	Gray or pale-reddish-brown, very gravelly sand interstratified with crossbedded sand and clay-silt beds; includes areas of Holocene alluvium and swamp deposits.	Not a major aquifer; deposits are generally less than 20 feet thick. Median yield for nine wells is 50 gal/min. Extensive areas of chemical contamination.
	Dark-reddish-brown, cross-stratified, feldspathic quartz sand and some thin beds of fine gravel and rare layers of clay or silt.	Thin deposits generally above the water table. Not used as a source of supply
BRYN MAWR FORMATION Tbm	Reddish-brown high-level terrace deposits; gravelly sand and some silt. Age uncertain.	
DIABASE Jd	Dark-gray, medium- to coarse-grained diabase, composed of labradorite and various pyroxenes; occurs as dikes and sheets.	Not utilized as an aquifer
CONESTOGA FORMATION OCc	Light-gray, thin-bedded, impure limestone having shale partings; conglomeratic at base; includes micaceous limestone in upper part, phyllite in middle, and alternating dolomite and limestone in lower part.	Very small areal extent, not important as an aquifer.
CHICKIES FORMATION Cch	Light-gray, hard, massive quartzite and quartz schist, thin interbeds of dark slate at top	Very small areal extent; not important as an aquifer
METADIABASE md	Dark-gray, fine-grained intrusive rock; locally, mineralogy is altered and unit has greenish color.	Not utilized as an aquifer
[illegible] pg	White, coarse- to medium-grained granitic pegmatite; contacts range from sharp to narrowly gradational, some zoning in places.	Not utilized as an aquifer.
ANORTHOSITIC GNEISS	Light- to dark-bluish-gray, medium- to coarse-grained gneiss; predominantly plagioclase, local alteration minerals.	Yields of six domestic wells range from 1 to 35 gal/min. Water is acidic, moderately hard to hard, and low in dissolved solids.
GRANODIORITIC GNEISS	Pink to white, rarely dark, coarse- to very fine grained granodioritic gneiss and granite; moderate to strong foliation; commonly contains biotite and muscovite.	Domestic wells yield up to 100 gal/min, the median yield is 10 gal/min. Water is slightly acidic, generally soft to moderately hard, and low in dissolved solids.
OCTORARO FORMATION	Greenish-gray to silvery-gray, fine- to medium-grained phyllite, finely foliated and laminated, locally sheared.	Small areal extent, water-bearing properties are unknown.
WISSAHICKON FORMATION / WISSAHICKON FORMATION	Dark- to light-gray, well foliated schist and gneiss, having some quartz- and/or feldspar-rich layers; quartz, feldspar, biotite, and muscovite are primary minerals; sillimanite, kyanite, andalusite, or garnets occur, depending upon degree of metamorphism.	Most productive consolidated rock aquifer. Yields range to 300 gal/min; the median yield is 20 gal/min. Water is acidic, generally soft to moderately hard, and low in dissolved solids. Thirty-eight percent of the wells exceed the maximum contaminant level of the U.S. Environmental Protection Agency for iron, and 62 percent exceed the maximum contaminant level for manganese.
MAFIC GNEISS, HORNBLENDE-BEARING	Dark, medium-grained, hornblende-bearing gneiss; foliated.	Domestic wells yield up to 150 gal/min; the median yield is 10 gal/min. Water is acidic, generally soft to moderately hard, and low in dissolved solids.
MAFIC GNEISS, PYROXENE-BEARING	Dark, medium grained, pyroxene-bearing gneiss; foliated	
ULTRAMAFITE	Pale- to dark-green, and gray serpentine; locally contains anthophyllite, talc, and/or chlorite; commonly has sheared appearance.	The median yield for nine domestic wells is 18 gal/min. Water is slightly alkaline, moderately hard to very hard, and low in dissolved solids.
COCKEYSVILLE MARBLE	White to light-bluish-gray, finely to coarsely crystalline marble, locally contains scattered tan phlogopite flakes.	Very small areal extent, not important as an aquifer
FELSIC GNEISS, HORNBLENDE-BEARING Yfh	Light- to medium-gray, medium-grained gneiss; finely to coarsely layered, contains potassium feldspar, hornblende, and garnet.	Domestic wells yield up to 100 gal/min, the median yield is 10 gal/min. Water is slightly acidic, generally soft to moderately hard, and low in dissolved solids.
FELSIC GNEISS, PYROXENE-BEARING Yfpg	Light- to dark-gray, fine- to coarse-grained gneiss; contains orthoclase, mesoperthite, hypersthene, kyanite, and garnet.	
MAFIC GNEISS, HORNBLENDE-BEARING Ybmg	Dark, medium-grained hornblende-bearing gneiss; foliated	Domestic wells yield up to 150 gal/min; the median yield is 10 gal/min. Water is acidic, generally soft to moderately hard, and low in dissolved solids.
MAFIC GNEISS, PYROXENE-BEARING Ypmg	Dark, medium-grained pyroxene-bearing gneiss.	

[1] The stratigraphic nomenclature follows the usage of the Pennsylvania Geological Survey and does not in all cases conform to the usage of the U.S. Geological Survey

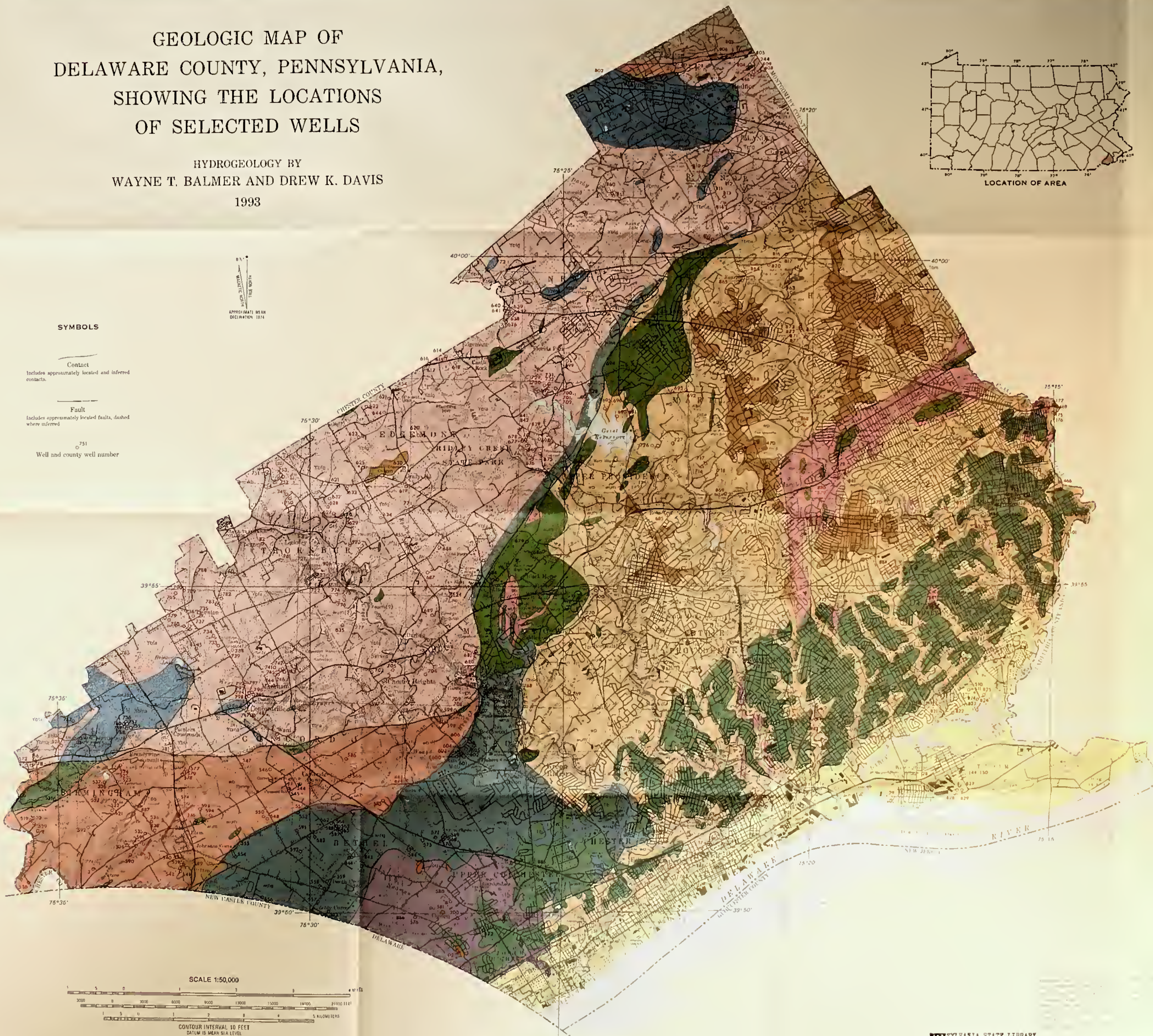
CORRELATION OF GEOLOGIC UNITS

SYMBOLS

Contact
Includes approximately located and inferred contacts.

Fault
Includes approximately located faults, dashed where inferred

751
Well and county well number



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